H. E. BARKER
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ARITHMETIC BY NICHOLAS PIKE.

Pike's Arithmetic is the only one mentioned in biographies of ABRAHAM LINCOLN as having been used by him. On page 37 of his Life of Lincoln, Herndon says in, reference to Lincoln's brief schooling: "All the scholars learned to cipher, and afterwards used Pike's Arithmetic."

This work was first issued in 1788, and copies of that date sell at $10.

H. E. Barker

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THE

New Complete System

OF

ARITHMETICK,

COMPOSED FOR

THE USE OF THE CITIZENS OF THE
UNITED STATES.

BY NICHOLAS PIKE, A. M.

MEMBER OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES.

Abridged for the Uſe of Schools.

FIFTH EDITION.

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EXPLANATION *of* CHARACTERS *uſed in this* TREATISE.

$=$	THE ſign of Equality: As 12 Pence $=$ 1 Shilling, ſignifies that 12 Pence are equal to 1 Shilling; and, in general that whatever precedes it is equal to what follows.
$+$	The ſign of Addition: As, $5+5=10$, that is, 5 added to 5 is equal to 10.—Read 5 plus 5, or 5 more 5 equal to 10.
$-$	The ſign of Subtraction: As, $12-4=8$, that is, 12 leſſened by 4 is equal to 8, or 4 from 12 and 8 remains.—Read 12 minus 4, or 12 leſs 4 equal to 8.
$\times$	The ſign of Multiplication: As, $6\times5=30$, that is, 6 multiply by 5 is equal to 30.—Read 6 into 5 equal to 30.
$\div$ *or* 6)30(	The ſign of Diviſion: As, $30\div5=6$, that is, 30 divided by 5 is equal to 6.—Read 30 by 5 equal to 6.
$\frac{875}{25}$	Numbers, placed fractionwiſe, do likewiſe denote diviſion, the Numerator or upper number being the dividend, and the Denominator or lower number, the diviſor, thus $\frac{875}{25}$ is the ſame as $875\div25=35$.
$:\ ::\ :$	The ſign of Proportion, thus, $2:4::8:16$, that is, As 2 is to 4 ſo is 8 to 16.
$\overline{\quad-2}+6=13$	Shews that the difference between 2 and 9 added to 6 is equal to 13.—Read 9 minus 2 plus 6 equal to 13; and that the line a top (called a *Vinculum*) connects all the numbers over which it is drawn.
$12-\overline{3+5}=4$	Signifies that the ſum of 3 and 5 taken from 12 leaves or is equal to 4.
$\overline{\quad}\|^{2}$	Signifies the ſecond Power or Square.
$\overline{\quad}\|^{3}$	Signifies the third Power or Cube.

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PIKE's ARITHMETICK

ABRIDGED.

ARITHMETICK is the Art or Science of computing by numbers, and is compriſed under five principal or fundamental Rules, viz. NOTATION or NUMERATION, ADDITION, SUBTRACTION, MULTIPLICATION and DIVISION.

NUMERATION

Teaches the different value of figures by their different places, and to read or write any ſum or number by theſe ten characters, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.—0 is called a cypher, and all the reſt are called figures or digits.

2. Beſides the ſimple value of figures, as above noted, they have each a local value, according to the following law; viz. In a combination of figures, reckoning from right to left, the figure, in the firſt place, repreſents its primitive ſimple value; that in the ſecond place, ten times its ſimple value, and ſo on; the value of the figure, in each ſucceeding place, being ten times the value of it, in that immediately preceding it.

3. The values of the places are eſtimated according to their order: The firſt is denominated the place of units; the ſecond, tens; the third, hundreds, and ſo on, as in the Table. Thus, in the number 3467: 7, in the firſt place, ſignifies only ſeven; 6, in the ſecond place, ſignifies 6 tens, or ſixty; 4, in the third place, four hundred; 3, in the fourth place, three thouſand; and the whole, taken together, is read thus; three thouſand four hundred and ſixty-ſeven.

4. A cypher, though it is of no ſignification itſelf, yet it poſſeſſes a place, and, when ſet on the right hand of figures, in whole numbers, increaſes their value in the ſame tenfold proportion; thus, 9 ſignifies only nine; but, if a cypher is placed on its right hand, thus, 90, it then becomes ninety.

To enumerate any parcel of figures, obſerve the following Rule.

Firſt. Commit the words at the head of the Table, viz. units, tens, hundreds, &c. to memory; then, to the ſimple value of each figure, join the name of its place, beginning at the left hand, and reading towards the right—*More particularly*—1. Place a dot under the right hand figure of the 2d, 4th, 6th, 8th, &c. half periods, and the figure over ſuch dot will, univerſally, have the name of thouſands.—2. Place the figures 1, 2, 3, 4, &c. as indices, over the 2d, 3d, 4th, &c. period: Theſe indices, will then ſhow the number of times the millions are involved—the figure under 1, bearing the name of millions, that under 2, the name of billions (or millions of millions) that under 3, trillions (or millions of millions of millions.)

EXAMPLE.

Sextilli.		Quintill.		Quatrill.		Trillions.		Billions.		Millions.		Units.	
th.	un.	th.	un.	th.	un.	th.	un.	th.	un.	th.	un.	c.x.t.c.x.u.	
	6		5		4		3		2		1		
913,	208;	000,	341;	620,	057;	219,	356;	809,	379;	120,	406;	129,	763
Thouſands		Thouſands		Thouſands		Thouſands		Thouſands		Thouſands		Thouſands	

NOTE 1. Billions is ſubſtituted for millions of millions; Trillions, for millions of millions of millions: Quatrillions, for millions of millions of millions of millions.

Quintillions, Sextillions, Septillions, Octillions, Nonmillions, Decillions, Undecillions, Duodecillions, &c. anſwer to millions ſo often involved as their indices reſpectively denote.

NOTE 2. The right hand figure of each half period has the place of units, of that half period; the middle one, that of tens, and the left hand one, that of hundreds.

THE APPLICATION.

Write down, in proper figures, the following numbers.

Fifteen.
Two hundred and ſeventy nine.
Three thouſand, four hundred and three.
Thirty ſeven thouſand, five hundred and ſixty ſeven.
Four hundred, one thouſand and twenty eight.
Nine millions, ſeventy two thouſand and two hundred.
Fifty five millions, three hundred, nine thouſand and nine.
Eight hundred millions, forty four thouſand, and fifty five.
Two thouſand, five hundred and forty three millions, four hundred and thirty one thouſand, ſeven hundred and two.

Write down, in words at length, the following numbers.

8	437	709040	3476194	7584397647
17	3010	879066	84094007	49163189186
129	76506	4091875	690748591	500098400700

Notation by Roman Letters.

I. One.
II. Two.
III. Three.
IV. Four.
V. Five.
VI. Six.
VII. Seven.
VIII. Eight.
IX. Nine.
X. Ten.
XI. Eleven.
XII. Twelve.
XIII. Thirteen.
XIV. Fourteen.
XV. Fifteen.
XVI. Sixteen.
XVI. Seventeen.
XVIII. Eighteen.
XIX. Nineteen.
XX. Twenty.
XXX. Thirty.

XL. Forty.
L. Fifty.
LX. Sixty.
LXX. Seventy.
LXXX. Eighty.
XC. Ninety.
C. Hundred.
CC. Two hundred.
CCC. Three hundred.
CCCC. Four hundred.
D or IↃ. Five hundred.
DC. Six hundred
DCC. Seven hundred.
DCCC. Eight hundred.
DCCCC. Nine hundred.
M or CIↃ. One thouſand.
IↃↃ. Five thouſand.
IↃↃↃ. Fifty thouſand.
IↃↃↃIↃↃↃ. Five hund. thou.
MDCCCIV. One thouſand eight hundred and four.

A leſs literal number, placed after a greater, always augments the value of the greater; if put before, it diminiſhes it. Thus, VI is 6; IV is 4; XI is 11; IX is 9, &c.

ADDITION

Is the putting together of two or more numbers, or ſums, to make them one total, or whole ſum.

SIMPLE ADDITION

Is the adding of ſeveral integers or whole numbers together, which are all of one kind, or ſort; as, 7 pounds, 12 pounds and 20 pounds, being added together, their aggregate, or ſum total, is 39 pounds.

RULE.

RULE.

Having placed units under units, tens under tens, &c. draw a line underneath, and begin with the units: After adding up every figure in that column, conſider how many tens are contained in their ſum, and, placing the exceſs under the units, carry ſo many, as you have tens, to the next column, of tens: Proceed in the ſame manner through every column, or row, and ſet down the whole amount of the laſt row.

PROOF.

Begin at the top of the ſum, and reckon the figures downwards, in the ſame manner as they were added upwards, and, if it be right, this aggregate will be equal to the firſt. Or, cut off the upper line of figures, and find the amount of the reſt; then, if the amount and upper line, when added, be equal to the ſum total, the work is ſuppoſed to be right.

ADDITION and SUBTRACTION TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	5	6	7	8	9	10	11	12	13	14
3	5	6	7	8	9	10	11	12	13	14	15
4	6	7	8	9	10	11	12	13	14	15	16
5	7	8	9	10	11	12	13	14	15	16	17
6	8	9	10	11	12	13	14	15	16	17	18
7	9	10	11	12	13	14	15	16	17	18	19
8	10	11	12	13	14	15	16	17	18	19	20
9	11	12	13	14	15	16	17	18	19	20	21
10	12	13	14	15	16	17	18	19	20	21	22

When you would add two numbers, look one of them in the left hand column, and the other atop, and in the common angle of meeting, or, at the right hand of the firſt; and under the ſecond, you will find the ſum—as, 5 and 8 is 13.

When you would ſubtract: Find the number to be ſubtracted in the left hand column, run your eye along to the right hand till you find the number from which it is to be taken, and right over it, atop, you will find the difference—as, 8, taken from 13, leaves 5.

EXAMPLES.

1.	2.	3.	4.	5.	6.
£.	lb.	Cwt.	Miles.	Yards.	£.
1	12	123	1234	12345	987654321
2	34	456	5678	67890	123456789
3	56	789	9098	98765	234567891
4	78	12	7654	43210	345678910
5	90	345	3210	12345	456789123
6	1	678	69	67890	567879287
7	23	901	4713	74100	678900028
8	45	234	131	64786	789400690
9	67	567	9128	19876	548769138

7.	8.	9.	10.
1234567	1234567	67	1234567
2345678	723456	123	9876543
3456789	34565	4567	2102865
4567890	4566	89093	4321234
5678209	333	654321	5682098
6789098	90	1234567	6543218

SUBTRACTION

Teaches to take a leſs number from a greater, to find a third, ſhewing the inequality, exceſs or difference between the given numbers; and it is both ſimple and compound.

SIMPLE SUBTRACTION

Teaches to find the difference between any two numbers, which are of a like kind.

RULE.

Place the larger number uppermoſt, and the leſs underneath, ſo that units may ſtand under units, tens under tens, &c. then, drawing a line underneath, begin with the units, and ſubtract the lower from the upper figure, and ſet down the remainder; but if the lower figure be greater than the upper, borrow ten, and ſubtract the lower figure therefrom: To this difference, add the upper figure, which, being ſet down, you muſt add one to the ten's place of the lower line, for that which you borrowed; and thus proceed through the whole.

PROOF.

In either ſimple, or compound Subtraction, add the remainder and the leſs line together, whoſe ſum, if the work be right, will be equal to the greater line:—Or, ſubtract the remainder from the greater line, and the difference will be equal to the leſs.

EXAMPLES,

EXAMPLES.

	1.	2.	3.	4.	5.	6.
	£.	£.	*Miles.*	*Yards.*	*Feet.*	*Cwt.*
From	25	305	4670	58934	879647	9187641
Take	12	103	4020	6182	164348	91843
Rem.						
Proof.						

7.	8.	9.
100200300400500600700800900	10000	1000000
98076054032011023045067089	9999	1

MULTIPLICATION

May be accounted the moſt ſerviceable Rule in Arithmetic. It teaches how to increaſe the greater of two numbers given, as often as there are units in the leſs; performs the work of many additions in the moſt compendious manner; brings numbers of great denominations into ſmall, as pounds into ſhillings, pence, or farthings, &c. and, by knowing the value of one thing, we find the value of many.

It conſiſts of three parts.

1. The Multiplicand, or number given to be multiplied, and, commonly, the largeſt number.

2. The Multiplier, or number to multiply by, commonly, the leaſt number.

3. The Product is the reſult of the work, or the anſwer to the queſtion.

SIMPLE

SIMPLE MULTIPLICATION

Is the multiplying of any two numbers together, without having regard to their ſignification; as, 7 times 8 is 56, &c.

MULTIPLICATION *and* DIVISION TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

To learn this Table, for Multiplication: Find your multiplier in the left hand column, and your multiplicand atop, and in the common angle of meeting, or againſt your multiplier, along at the right hand, and under your multiplicand, you will find the product, or anſwer.

To learn it, for Diviſion: Find the diviſor in the left hand column, and run your eye along the row to the right hand until you find the dividend; then, directly over the dividend, atop, you will find the quotient, ſhowing how often the diviſor is contained in the dividend.

CASE I.

When the multiplier is not more than 12, always placing the greateſt number uppermoſt, ſet the multiplier underneath, units under units, &c. and begin as the Table directs, ſetting down the unit figure under units, and carrying the tens to the next place, in all reſpects as in ſimple addition.

PROOF.

Multiply the multiplier by the multiplicand.

EXAMPLES.

	1.	2.	3.	4.
	37934	769308	4980076	763896
	2	3	4	5
Prod.				

5.	6.	7.	8.
67589	503764	3918295	9164785
6	7	8	9

9.	10.	11.
4879567	5864734	8593478649
10	11	12

CASE II.

When the multiplier conſiſts of more places than one, multiply each figure in the multiplicand by every figure in the multiplier, beginning with the units, and placing the firſt figure of each product exactly under its multiplier: Laſtly, add theſe ſeveral products together, in the ſame order as they ſtand, and their ſum will be their total product.

EXAMPLES.

	1.	2.	3.
	6357534	8324629	46293845
	47	59	76
	44502738		
	25430136		
Prod.	298804098		

4.	5.	6.
647906	760483	91867584
4873	9152	6875
3157245938	6959940416	631589640000

CASE III.

When the multiplier is a compoſite number, that is, when it is produced by the multiplication of any two numbers in the Table, multiply the multiplicand by one of thoſe figures, firſt, and that product by the other: And the laſt product will be the total required.

EXAMPLES.

	1.	2.	3.
Mult.	59375 by 35.	39187 by 48.	91632 by 56.
	7		
7×5=35	415625		
	5		
	2078125		

Mult.

	4.	5.	6.
Mult.	91738 by 81.	35963 by 72.	847396 by 99.
	7.	8.	9.
Mult.	38462 by 108.	749357 by 121.	9043278 by 144.

CASE IV.

When there are cyphers on the right hand of, either the multiplicand, or multiplier, or both, neglect thoſe cyphers; then place the ſignificant figures under one another, and multiply by them only; add them together, as before directed, and place to the right hand as many cyphers as there are in both the factors.

EXAMPLES.

	1.	2.	3.
	67910	956700	930137000
	5600	320	9500
Prod.	380296000	306144000	8836301500000

	4.	5.	6.
	359260	8196000	623000
	7364	59180	589000
Prod.	2645590640	485039280000	366947000000

CASE V.

When there are cyphers between the ſignificant figures of the multiplier, omit multiplying by them, and place the firſt figure of each product of the ſignificant figures, exactly under that figure by which you multiply; laſtly, add them together, and their ſum will be the total product.

EXAMPLES.

EXAMPLES.

	1.	2.	3.
	5397	85630	48976850
	8009	7005	400030
	48573		
	43176		
Prod.	43224573	599838150	19592209305500

CASE VI.

To multiply by 10, 100, 1000, &c. ſet down the multiplicand underneath, and join the cyphers in your multiplier to the right hand of them.

EXAMPLES.

	1.	2.	3.	4.
	57935	84935	613975	8473965
	10	100	1000	10000
Prod.	579350			

CASE VII.

To multiply by 99, 999, &c. in one line; place as many dots at the right hand of the multiplicand, as there are figures of 9 in your multiplier, which dots ſuppoſe to be cyphers; then, beginning with the right hand dot, ſubtract the *given* multiplicand from the *new* one, and the remainder will be the total product.

EXAMPLES.

Mult.	371967...	According to the Rule it will ſtand thus,	371967...	Minuend.
by	999		371967	Subtrah.
	371595033		371595033	Rem. or total Prod.

CASE

CASE VIII.

To multiply by 13, 14, 15, &c. to 19: Place your multiplier at the right of the multiplicand, with the ſign of multiplication between them, and multiply with the unit figure, only, of the multiplier, removing the product one figure to the right hand of the multiplicand; then add all together, and their ſum will be the total product.

EXAMPLES.

	1.	2.	3.
	75964×13	7598×14	76013×15
	227892		
Prod.	987532		

	4.	5.	6.
	8196×16	3179×17	4679×19
Prod.			

CASE IX.

To multiply by 101, 102, 103, &c. to 109: Multiply by the right hand figure, only, of the multiplier, removing the product two figures to the right hand of the multiplicand: Add all together, and the ſum will be the total product. In the ſame manner proceed with 1001, 1002, &c. removing the product three figures.

EXAMPLES.

EXAMPLES.

	1.	2.	3.
	64795 × 101	79164 × 102	37598 × 103
	64795		
Prod.	6544295		

	4.	5.	6.
	73967 × 104	84973 × 105	748794 × 106
Prod.			

	7.	8.	9.
	87958 × 107	395867 × 108	5916379 × 109
Prod.			

CASE X.

To multiply by 21, 31, 41, &c. to 91: Multiply by the ten's figure, only, of the multiplier, and ſet the unit figure of the product under the place of tens; add them all together, and their ſum will be the total product.

EXAMPLES.

1.	2.	3.
73918 × 21	56934 × 31	86789 × 41
147836		
1552278		

4.	5.	6.
759846 × 51	37954 × 61	73958 × 71

DIVISION

Teaches to ſeparate any number, or quantity given, into any number of parts aſſigned: or to find how often one number is contained in another; or from any two numbers given, to find a third, which ſhall conſiſt of ſo many units, as the one of thoſe given numbers is comprehended in the other; and is a conciſe way of performing ſeveral Subtractions.

There are four principal parts to be noticed in Diviſion, viz.

1. The Dividend, or number given to be divided.

2. The Diviſor, or number given to divide by.

3. The Quotient, or anſwer to the queſtion, which ſhows how often the diviſor is contained in the dividend.

4. The Remainder (which is always leſs than the diviſor, and of the ſame name with the dividend) is very uncertain, as there is ſometimes a remainder, and ſometimes none.

Diviſion is both ſimple and compound.

PROOF.

Multiply the diviſor and quotient together, and add the remainder, if there be any, to the product: If the work be right, that ſum will be equal to the dividend.

SIMPLE DIVISION

Is the dividing of one number by another, without regard to their values: As, 56, divided by 8, produces 7 in the quotient: That is, 8 is contained 7 times in 56.

CASE I.*

RULE.

Firſt, ſeek how many times the diviſor is contained in a competent number of the firſt figures of the dividend; when found, place the figure in the quotient; multiply the diviſor by this quotient figure; place the product under the left hand figures of the dividend; then ſubtract it therefrom, and bring down the next figure of the dividend to the right hand of the remainder: If, when you have brought down a figure to the remainder, it is ſtill leſs than the diviſor, a cypher muſt be placed in the quotient, and another figure be brought down; after which, you muſt ſeek, multiply, and ſubtract, till you have brought down every figure of the dividend.

EXAMPLES.

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* When there is no remainder to a diviſion, the quotient is the abſolute and perfect anſwer to the queſtion; but where there is a remainder, it may be obſerved, that it goes ſo much towards another time as it approaches the diviſor; thus, if the remainder be half the diviſor, it will go half of a time more, and ſo on; in order, therefore, to complete the quotient, put the laſt remainder to the end of it, above a line, and the diviſor below it.

It is ſometimes difficult to find how often the diviſor may be had in the numbers of the ſeveral ſteps of the operation: The beſt way will be to find how often the firſt figure of the diviſor may be had in the firſt, or two firſt figures of the dividend, and the anſwer, made leſs by one or two, is, generally, the figure wanted; but if, after ſubtracting the product of the diviſor and quotient from the dividend, the remainder be equal to, or exceed, the diviſor, the quotient figure muſt be increaſed accordingly.

EXAMPLES.

Diviſor. Dividend. Quotient.
3)175817(58605
15

25
24

18
18

17
15

2 Rem.

Proof.
58605 Quotient.
× 3 Diviſor + 2

175817

In this example, I find that 3, the diviſor, cannot be contained in the firſt figure of the dividend; therefore, I take two figures, viz. 17, and inquire how often 3 is contained therein, which finding to be 5 times, I place the 5 in the quotient, and multiply the diviſor by it, ſetting the firſt figure of the multiplication under the 7 in the dividend, &c. I then ſubtract 15 from 17, and find a remainder of 2, to the right hand of which, I bring down the next figure of the dividend, viz. 5; then, I inquire how often the diviſor 3 is contained in 25, and, finding it to be 8 times, I multiply by 8, and proceed as before, till I bring down the 1, when, finding I cannot have the diviſor in 1, I place 0 in the quotient, and bring down 7 to the 1, and proceed as at the firſt.

Obſerve, that in multiplying by 3, I add in the 2.

EXAMPLES.

2.
29)153598(5296
145
85
58
279
261
188
174
14

3.
6493)91876375(14150
6493
26946
25972
9743
6493
32507
32465
425

4.
28)503775(

5.
35)197184(

6.
85)994466(

7.
236)3798567(

8.
3479)483956795(

9.
5679)19647394(

10.
38473)119184693(

11.
641976)9187642959(

12.
5823789)791822376496(

13.
123456789)121932631112635269(

CASE II.

When there is one cypher, or more, at the right hand of the diviſor, it or they muſt be cut off; alſo, cut off the ſame number of figures from the dividend, and then proceed as in caſe firſt: But the figures which were cut off from the dividend muſt be placed at the right hand of the remainder.

EXAMPLES.

EXAMPLES.

1.

65|00)3794326|75(58374
325

544
520

243
195

482
455

276
260

1675 Rem.

2.

5193|000)8937643|893(

3.

9170)476583(

4.

875000)91764789430000(

5.
Quot. Rem.
1|0)9584|6

6.
Quot. Rem.
1|00)76495|30

7.
Quot. Rem.
1|000)93751839|462

Note. In dividing by 10, 100, 1000, &c. when you cut off as many figures from the dividend, as there are cyphers in the diviſor, your work is done; thoſe figures, cut off at the right hand, are the remainder, and thoſe on the left, the quotient, as above.

CASE III.

Short Diviſion is, when the diviſor does not exceed 12.

RULE.

Firſt, ſeek how often the diviſor can be had in the firſt figure, or figures, of the dividend; which, when found, place in the quotient; then, *mentally*, multiply your diviſor by the figure placed in the quotient, and ſubtract the product from the like number of the left hand figures of your dividend, and the units which remain muſt be accounted ſo many tens, which you muſt ſuppoſe to ſtand at the left hand of the next figure in the dividend, and to be reckoned with it; then, ſeek how often you can have your diviſor in thoſe two figures; but, if nothing remain, you muſt then ſeek how often your diviſor is contained in the next figure, or figures, and thus proceed till you have done.

EXAMPLES.

Diviſor. Dividend. 2. 3. 4.
2)71935 3)51903 5)633795 6)8471937

Quot. 35967—1

5. 6. 7.
8)5437846 9)45963784 11)91843756

CASE IV.

When the diviſor is ſuch a number, that any two, or more, figures in the table, being multiplied together, will produce it, divide the given dividend by one of thoſe figures; the quotient, thence ariſing, by the other, and ſo on; and the laſt quotient will be the anſwer.*

EXAMPLES.

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* As the learner, at preſent, is ſuppoſed to be unacquainted with the nature of fractions, and as the quotient is incomplete without the remainder—I ſhall here give a rule for finding the true remainder, without having recourſe to fractions.

EXAMPLES.

Firſt Method.	Second Method.
9)196473	8)196473
8)21830	9)24559
Quot. 2728—57	Quot. 2728—57

In the *firſt* operation, in dividing by 9, 3 remains, and by 8, 6 remains ; which being the laſt remainder; I multiply it by the firſt diviſor 9, and add in the firſt remainder 3, and they make 57, the true remainder. In the *ſecond* method, dividing by 8, 1 remains, and by 9, 7 remains ; I therefore multiply 7, the laſt remainder, by 8, adding in the 1, and they make 57, as before.

2. 36)79638
3. 25)197835
4. 84)93975
5. 54)93738764
6. 121)75323939
7. 132)38473692
8. 144)891376429732

Supplement to Contractions in Multiplication.

The ſhorteſt method of multiplication, when the multiplier is any even part of 100, 1000, &c. is by diviſion ; for if the multiplicand be increaſed by a number of cyphers equal to the places in the multiplier, and a part of

---

RULE.

Multiply the quotient by the diviſor ; ſubtract the product from the dividend, and the reſult will be the true remainder.

The Rule which is moſt commonly made uſe of, when the diviſor is a compoſite number, is,

RULE II.

Multiply the laſt remainder by the preceding diviſor, or laſt but one, and to the product add the preceding remainder ; multiply this ſum by the next preceding diviſor, and to the product add the next preceding remainder ; and ſo on, till you have gone through all the diviſors and remainders, to the firſt.

of that product taken for the ſame proportion, which the multiplier bears to 1, and the ſame number of cyphers annexed to it, the quotient will be the product.

1. Mult. 39756 into 125.	2. Mult. 57638 by $33\frac{1}{3}$.
$125=\frac{1}{8}$ of 1000, wherefore,	$33\frac{1}{3}=\frac{1}{3}$ of 100, therefore,
8)39756000	3)5763800
4969500 Product.	$1921266\frac{2}{3}$ Prod.

TABLES IN COMPOUND ADDITION.

1. MONEY.

			Marked
4 Farthings	make 1	Penny.	qrs. d.
12 Pence		Shilling.	s.
20 Shillings		Pound.	£.

Farthings.
4 = 1 Penny.
48 = 12 = 1 Shilling.
960 = 240 = 20 = 1 Pound.

PENCE TABLES.

d.	s.	d.	d.	s.	d.
20 =	1	8	120 =	10	0
30 =	2	6	130 =	10	10
40 =	3	4	140 =	11	8
50 =	4	2	150 =	12	6
60 =	5	0	160 =	13	4
70 =	5	10	170 =	14	2
80 =	6	8	180 =	15	0
90 =	7	6	190 =	15	10
100 =	8	4	200 =	16	8
110 =	9	2			

s.		d.	s.		d.
1	=	12	11	=	132
2	=	24	12	=	144
3	=	36	13	=	156
4	=	48	14	=	168
5	=	60	15	=	180
6	=	72	16	=	192
7	=	84	17	=	204
8	=	96	18	=	216
9	=	108	19	=	228
10	=	120	20	=	240

2. TROY WEIGHT.*

			Marked
24 Grains	make 1	Pennywt.	grs. pwt.
20 Pennyweights		Ounce.	oz.
12 Ounces		Pound.	℔ *or* lb.

3. AVOIRDUPOIS WEIGHT.†

			Marked
16 Drams	make	1 Ounce.	dr. oz.
16 Ounces		1 Pound,	℔
28 Pounds		¼ of a hundred wt.	qr.
4 Quarters		100 wt. *or* 112 lbs.	Cwt.
20 Hund. wt.		1 Ton.	T.

4. APOTHECARIES'

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* By this weight are weighed Gold, Silver, Jewels, Electuaries, and all Liquors.

NOTE. 175 Troy ounces are preciſely equal to 192 Avoirdupois ounces, and 175 Troy pounds are equal to 144 Avoirdupois. 1lb. Troy=5760 grains, and 1lb. Avoirdupois=7000 grains.

† By Avoirdupois are weighed all coarſe and droſſy goods, grocery and chandlery wares; bread, and all metals, except Gold and Silver.

4. APOTHECARIES' WEIGHT.*

20 Grains	make 1	Scruple. *Marked* gr.	℈
3 Scruples		Dram.	ʒ
8 Drams		Ounce.	℥
12 Ounces		Pound.	℔

5. CLOTH MEASURE.

2¼ Inches	make 1	Nail. *Marked* in.	na.
4 Nails, or 9 Inches		Quarter of a yard.	qr.
4 Quarters, or 36 In.		Yard.	yd.
3 Quarters, or 27 In.		Ell Flemiſh.	E. Fl.
5 Quarters, or 45 In.		Ell Engliſh.	E. E.
6 Quarters, or 54 In.		Ell French.	E. Fr.
4 Qrs. 1⅕ In. or 37 In. and 1 fifth		Ell Scotch.	E. Sc.
3 Qrs. and 2 thirds		Spaniſh Var.	

6. LONG MEASURE.†

3 Barley corns	make 1	Inch. *Marked* bar.	in.
12 Inches		Foot.	ft.
3 Feet		Yard.	yd.
5½ Yds. or 16½ feet		Rod, Perch, or Pole.	pol.
40 Poles		Furlong.	fur.
8 Furlongs		Mile.	mile.
69½ Stat. miles *nearly*		Degree of a great Circle.	deg.
360 Degrees		A great Circle of the Earth.	

Or,

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* All the weights now uſed by Apothecaries, above grains, are Avoirdupois.

The Apothecaries' pound and ounce, and the pound and ounce Troy, are the ſame, only differently divided and ſubdivided.

† The uſe of Long Meaſure is to meaſure the diſtance of places, or any other thing, where length is conſidered without regard to breadth.

NOTE

Or, in Meaſuring Diſtances,

$7\frac{92}{100}$ Inches	make	1 Link.
25 Links		1 Pole.
100 Links		1 Chain.
10 Chains		1 Furlong.
8 Furlongs		1 Mile.

7. TIME.*

60 Seconds	make 1	Minute. *Marked*	s. m.
60 Minutes		Hour.	h.
24 Hours		Day.	d.
7 Days		Week.	w.
4 Weeks		Month.	mo.
13 Mo. 1 day & 6 hours		Julian Year.	yr.

8. LAND, OR SQUARE MEASURE.

144 Inches	make 1	Square foot.
9 Feet		—— Yard.
$30\frac{1}{4}$ Yards, or $272\frac{1}{4}$ Feet		—— Pole.
40 Poles		—— Rood.
4 Roods, or 160 Rods, or 4840 yards		—— Acre.
640 Acres		—— Mile.

9. SOLID

NOTE: 60 geometrical miles make a degree—4 inches a hand—5 feet a geometrical pace. 6 points make 1 line, 12 lines an inch, 12 inches a foot, and 6 feet 1 French toiſe, or fathom, equal to 6 feet 4 inches, 8,812875 lines, Engliſh meaſure. 1 Engliſh foot equal to 11 inches, 3,1154 lines, French. 66 feet, or 4 poles, make a Gunter's chain. 3 miles make a league.

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* By the calendar, the year is divided in the following manner:

Thirty days hath September, April, June, and November;
February twenty eight alone, and all the reſt have thirty one.

When you can divide the year of our Lord by 4, without any remainder, it is then Biſſextile, or Leap Year, in which February has 29 days.

9. SOLID MEASURE.*

1728 Inches	make 1	Foot.
27 Feet		Yard.
40 Ft. of round tim. or 50 ft. of hewn tim.		Ton or Load.
128 Sol. Ft. i.e. 8 in len. 4 in brdth. & 4 in ht.		Cord of Wood.

10. WINE MEASURE.†

			Marked
2 Pints	make 1	Quart.	pts. qts.
4 Quarts		Gallon.	gal.
10 Gallons		Anchor of Brandy.	anc.
18 Gallons		Runlet.	run.
31½ Gallons		Half hogſhead.	½hhd.
42 Gallons		Tierce.	tier.
63 Gallons		Hogſhead.	hhd.
2 Hogſheads		Pipe or Butt.	P. or B.
2 Pipes		Tun.	Tun.

11. ALE OR BEER MEASURE.‡

			Marked
2 Pints	make 1	Quart.	pts. qts.
4 Quarts		Gallon.	gal.
8 Gallons		Firk. of Ale in Lon.	A.fir.
8½ Gallons		Firkin of Ale or Beer.	
9 Gallons		Fir. of Beer in Lon.	B. fir.
2 Firkins		Kilderkin.	kil.
2 Kilderkins		Barrel.	bar.
1½ Bar. or 45 Gall.		Hogſhead of Beer.	hhd.
2 Barrels		Puncheon.	pun.
3 Bar. or 2 Hhd.		Butt.	butt.

12. DRY

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* By Solid Meaſure are meaſured all things that have length, breadth, and depth.

† All Brandies, Spirits, Perry, Cider, Mead, Vinegar, Honey, and Oil, are meaſured by Wine Meaſure; Honey is, commonly, ſold by the pound Avoirdupois.

‡ Milk is ſold by the Beer quart.

12. DRY MEASURE.*

2 Pints	make 1	Quart. *Marked* pts.	qts.
2 Quarts		Pottle.	pot.
2 Pottles		Gallon.	gal.
2 Gallons		Peck.	pk.
4 Pecks		Buſhel.	bu.
2 Buſhels		Strike.	ſtr.
2 Strikes		Coom.	co.
2 Cooms		Quarter.	qr.
4 Quarters		Chaldron.	ch.
4½ Quarters		Chaldron in London.	
5 Quarters		Wey.	wey.
2 Weys		Laſt.	laſt.

COMPOUND ADDITION

Is the adding of ſeveral numbers together, having different denominations, as Pounds, Shillings, Pence, &c. Tons, Hundreds, Quarters, &c.

RULE.

1. Place the numbers, ſo that thoſe of the ſame denomination may ſtand directly under each other.

2. Add the firſt column or denomination together as in whole numbers; then divide the ſum by as many of the ſame denomination as make one of the next greater, ſetting down the remainder under the column added, and carry the quotient to the next ſuperior denomination, continuing the ſame to the laſt, which add as in ſimple addition.

1. MONEY.

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* This meaſure is applied to all dry goods, as Corn, Seed, Fruit, Roots, Salt, Sand, Oyſters, and Coals.

A Wincheſter Buſhel is 18½ inches diameter, and 8 inches deep.

1. MONEY.

EXAMPLES.

1.

£.	s.	d.
9	16	10
7	10	9
0	18	6
5	11	11

2.

£.	s.	d.	qr.
47	17	6	2
3	9	10	3
75	13	9	1
4	11	11	0

3.

£.	s.	d.	qr.
847	11	11	3
419	19	6	1
59	6	10	0
747	16	1	2

4.

£.	s.	d.	qr.
915	10	10	2
64	8	9	1
5	16	11	3
419	2	10	2

5.

£.	s.	d.	qr.
764	13	10	2
43	9	8	1
59	17	11	2
817	16	9	3

6.

£.	s.	d.	qr.
584	19	10	3
765	14	8	1
91	17	10	2
18	19	6	3

FRENCH MONEY.

12	Deniers, or Pence	make 1	Sol, or Shilling.
20	Sols, or Shillings		Livre, or Pound.
3	Livres, or Pounds		Crown of exchange.
6	Livres, or Pounds		Real Cro. or, ecu d'argent.

Cr. exc.	liv.	ſols.	den.
976	2	17	10
379	1	12	6
491	1	0	11
592	2	15	8

Ecu d'ar.	liv.	ſols.	den.
567	5	13	11
389	1	19	6
548	4	17	10
632	3	11	9

DUTCH MONEY.

8	Phennings	make 1	Groat.
2	Groats, or 16 Phennings		Stiver.
20	Stivers		Guilder or Florin.

ALSO,

12 Groats, or 6 Stivers	make	1	Schilling.
20 Schillings, or 6 Guilders			Pound.

Guild.	ſtiv.	gr.	ph.
167	17	1	7
348	12	0	6
491	13	1	3
749	19	1	4

Guild.	ſtiv.	ph.
549	19	14
317	21	12
859	13	8
467	10	15

£.	ſch.	gro.
357	18	11
508	12	6
497	13	10
618	17	8

2. TROY WEIGHT.

1.

lb.	oz.	pwts.
767	10	17
39	6	9
417	11	16
935	9	17

2.

lb.	oz.	pwts.	gr.
649	11	19	20
32	9	6	5
841	10	11	19
473	9	17	23

3.

lb.	oz.	pwts.	gr.
859	9	15	20
437	10	17	22
641	11	6	0
738	9	12	18

3. AVOIRDUPOIS WEIGHT.

1.

lb.	oz.	dr.
19	13	12
21	9	6
4	15	15
22	10	5

2.

T.	Cwt.	qrs.	lb.
59	13	2	17
6	17	1	21
45	11	3	25
57	16	2	19

3.

T.	Cwt.	qrs.	lb.	oz.	dr.
91	17	2	25	13	15
19	9	0	17	10	12
14	13	2	0	9	11
47	11	3	19	14	0

4. APOTHECARIES' WEIGHT.

1.

ʒ	℈	gr.
9	1	17
3	2	19
6	1	17
4	0	6

2.

℥	ʒ	℈	gr.
10	7	3	19
6	3	0	12
7	6	1	17
9	5	2	12

3.

℔	℥	ʒ	℈	gr.
12	11	6	1	15
4	9	1	0	12
91	10	2	2	16
4	8	1	2	19

5. CLOTH MEASURE.

1.

Yd.	qr.	n.
70	2	3
3	3	1
42	3	3
57	2	2

2.

E.E.	qr.	n.
91	3	2
49	4	3
6	2	3
84	4	1

3.

E.Fl.	qr.	n.
914	2	3
49	2	1
561	3	0
84	0	2

6. LONG MEASURE.

1.

Pol.	ft.	in.
12	11	10
9	16	9
8	12	11
7	15	6

2.

Mil.	fur.	pol.
9	7	36
7	3	19
4	1	24
6	5	12

3.

Deg.	mi.	fur.	pol.	ft.	in.	bc.
759	56	6	29	15	10	2
317	39	1	36	11	6	1
497	63	7	24	9	8	1
562	17	0	11	13	11	0

7. TIME.

1.

W.	d.	h.	m.	s.
3	6	22	57	42
1	5	19	31	28
2	3	17	9	15
3	0	9	17	58

2.

Y.	mo.	d.
19	10	19
7	9	27
4	8	16
1	11	14

3.

Y.	mo.	w.	d.	h.	m.	s.
57	11	3	6	23	29	55
4	8	1	1	19	45	38
29	9	2	3	17	18	19
46	10	2	5	11	50	13

8. LAND, OR SQUARE MEASURE.

1.

Pol.	feet.	in.
36	179	137
19	248	119
12	96	75
18	110	122

2.

Yds.	ft.	in.
28	7	119
9	3	75
29	6	120
4	8	12

3.

Acres.	roo.	pol.	feet.	in.
756	3	37	245	128
29	1	28	93	25
416	2	31	128	119
37	1	19	218	20

9. SOLID MEASURE.

1.			2.			3.		
Ton.	feet.	in.	Yds.	feet.	in.	Cord.	feet	in.
29	36	1229	75	22	1412	37	119	1015
12	19	64	9	26	195	9	110	159
8	11	917	3	19	1091	8	127	1071
19	8	1001	28	15	1110	8	101	956

10. WINE MEASURE.

1.				2.				3.			
Tier.	gal.	qts.	pts.	Hhd.	gal.	qts.	pts.	Tun.	hhd.	gal.	qts.
37	39	3	1	51	53	1	1	37	2	37	2
9	17	2	1	27	39	3	0	19	1	59	1
4	28	0	0	9	18	0	1	28	2	0	0
32	19	1	1	0	9	2	1	19	0	47	1

11. ALE AND BEER MEASURE.

1.			2.			3.		
A.B.	fir.	gal.	B.B.	fir.	gal.	Hhd.	gal.	qts.
49	3	7	29	1	8	379	53	3
26	2	3	19	3	5	19	0	1
9	0	4	16	0	3	121	37	2
17	3	0	9	1	8	467	19	1

12. DRY MEASURE.

1.				2.				3.			
Qrs.	bu.	p.	qt.	Bu.	p.	qt.	pt.	Ch.	bu.	p.	qt.
64	7	3	7	37	2	5	1	37	27	3	5
9	4	1	5	19	3	7	0	6	29	1	7
19	6	2	1	16	2	0	1	15	30	0	0
4	0	2	0	5	1	6	1	4	11	3	0

COMPOUND SUBTRACTION

Teaches to find the difference, inequality, or exceſs, between any two ſums of divers denominations.

RULE.

Place thoſe numbers under each other, which are of the ſame denomination, the leſs being below the greater; begin with the leaſt denomination, and, if it exceed the figure over it, borrow as many units as make one of the next greater; ſubtract it therefrom; and to the difference add the upper figure, remembering, always, to add one to the next ſuperior denomination, for that which you borrowed.

1. MONEY.

1.

	£.	s.	d.	qr.
Borrowed	349	15	6	1
Paid	195	11	8	1
Remains to pay	154	3	10	0
Proof				

2.

	£.	s.	d.	q.
Lent	791	9	8	1
Received	197	16	4	2
Due to me				

3.

	£.	s.	d.	q.
From	439	9	10	1
Take	196	0	10	3
Rem.				

4.

£.	s.	d.	q.
843	12	1	3
746	15	0	2

5.

£.	s.	d.	q.
469	7	5	2
508	16	4	0

6.

	£.	s.	d.	
Borrowed	19372	12	6	
Paid at	293	16	8	0
	74	9	7	2
ſundry	9413	11	0	1
	1994	0	10	3
times	3914	19	0	0
	1064	17	9	1
Paid in all				
Rem. to be pd.				

7.

	£.	s.	d.	q.
Lent	27109	5	8	3
Rec. at	5196	15	10	0
	384	17	6	2
ſeveral	4187	18	11	1
	1649	16	8	0
times	917	9	10	3
	3196	0	2	1
Rec. in all				
Rem. due				

2. TROY WEIGHT.

	1.				2.				3.			
	lb.	oz.	pwt.	gr.	lb.	oz.	pwt.	gr.	lb.	oz.	pwt.	gr.
Bought	749	5	13	16	374	8	12	10	543	3	9	13
Sold	96	9	19	13	148	4	16	19	179	1	15	18
Rem.												

3. AVOIRDUPOIS WEIGHT.

	1.			2.			3.					
	lb.	oz.	dr.	C.	qr.	lb.	T.	cwt.	qr.	lb.	oz.	dr.
Bought	7	9	12	8	2	13	9	11	3	17	5	12
Sold	3	12	9	4	1	15	3	12	2	19	10	9
Rem.												

4. APOTHECARIES'

4. APOTHECARIES' WEIGHT.

1.

℔	℥	ʒ	℈	gr.
71	9	3	1	13
37	8	4	1	16

2.

℔	℥	ʒ	℈	gr.
65	10	6	2	1
31	8	4	2	0

3.

℔	℥	ʒ	℈	gr.
84	1	1	1	1
65	9	3	1	17

5. CLOTH MEASURE.

1.

Yd.	qr.	n.
35	1	2
19	1	3

2.

E.E.	qr.	n.
467	3	1
291	3	2

3.

E.Fl.	qr.	n.
765	1	3
149	2	1

4.

E.Fr.	qr.	n.
549	4	2
197	4	3

6. LONG MEASURE.

1.

Yd.	ft.	in.
28	2	10
67	2	11

2.

Mil.	fur.	pol.
76	3	11
27	3	21

3.

Deg.	m.	fur.	p.	yd.	ft.	in.	bar.
38	41	3	29	2	1	7	2
19	35	5	31	3	1	9	1

7. TIME.

1.

Mo.	d.	h.	m.	s.
6	17	13	27	19
1	21	16	41	35

2.

Y.	mo.	d.
7	3	13
4	2	19

3.

Y.	mo.	w.	d.	h.	m.	s.
48	9	2	5	19	27	31
19	9	3	4	20	19	49

8. LAND, OR SQUARE MEASURE.

1.

A.	R.	Pol.
29	1	10
24	1	25

2.

A.	R.	Pol.
29	2	17
17	1	36

3.

A.	R.	Pol	ft.	in.
56	3	19	27	110
29	0	21	210	129

9. SOLID

9. SOLID MEASURE.

1.

T.	ft.	in.
49	19	1100
38	36	1296

2.

Yds.	ft.	in.
79	11	917
17	25	1095

3.

Cords.	ft.	in.
349	97	1250
192	127	1349

10. WINE MEASURE.

1.

Tun.	gal.	qt.	pt.
79	1	2	1
38	1	3	1

2.

Tier.	gal.	qt.
19	17	1
12	29	2

3.

Tun.	hhd.	gal.
532	1	19
197	1	47

11. ALE AND BEER MEASURE.

1.

A.B. fir.	gal.	qt.
39	1	2	1
24	3	6	2

2.

B.B.	fir.	gal.	qt.	pt.
21	3	5	2	0
19	1	7	2	1

3.

Hhd.	gal.	qt.
769	17	1
391	42	3

12. DRY MEASURE.

1.

Qu.	bu.	pk.	qt.
56	2	2	1
43	3	1	2

2.

Bu.	pk.	qt.	pt.
91	1	3	2
29	2	1	1

3.

Chal.	bu.	pk.	qt.
39	12	2	1
24	25	3	2

PROBLEMS

Reſulting from a Compariſon *of the preceding Rules.*

Prob. 1. Having the ſum of two numbers, and one of them given, to find the other.

Rule. Subtract the given number from the given ſum, and the remainder will be the number required.

Let 288 be the ſum of two numbers, one of which is 115, the other is required.

From 288 the ſum,
Take 115 the given number.

Rem. 173 the other.

Prob. 2. Having the greater of two numbers, and the difference between that and the leſs given, to find the leſs.

Rule. Subtract the one from the other.

Let the greater number be 325, and the difference between that and the other, 198: What is the other?

From 325 the greater,
Take 198 the difference.

Rem. 127 the leſs.

Prob. 3. Having the leaſt of two numbers given, and the difference between that and a greater, to find the greater.

Rule. Add them together.

Given { 127 the leſs number.
198 the difference.

Sum 325 the greater number required.

Prob. 4. Having the ſum and difference of two numbers given, to find thoſe numbers.

Rule. To half the ſum add half the difference, and the ſum is the greater; and from half the ſum take half the difference, and the remainder is the leſs.—Or, from the ſum take the difference, and half the remainder is the leaſt: To the leaſt add the given difference, and the ſum is the greateſt.

What are thoſe two numbers, whoſe ſum is 48, and difference 14?

2)48 2)14

$\frac{1}{2}$ ſum $=24$ $\frac{1}{2}$ diff. $=7$

$24+7=31$ the greater; and $24-7=17$ the leſs.

Or, $48-14\div2=17$; and $17+14=31$.

Prob. 5. Having the ſum of two numbers, and the difference of their ſquares given, to find thoſe numbers.

Rule. Divide the difference of their ſquares by the ſum of the numbers, and the quotient will be their difference: You will then have their ſum and difference, to find the numbers, by Prob. 4.

What two numbers are thoſe, whoſe ſum is 32, and the difference of whoſe ſquares is 256?

32)256(8 difference.
256

Half ſum	16
Half diff.	4
Greater	20
Leſs	12

Prob. 6. Having the difference of two numbers, and the difference of their ſquares given, to find thoſe numbers.

Rule. Divide the difference of their ſquares by the difference of the numbers, and the quotient will be their ſum; then proceed by Prob. 4.

What are thoſe two numbers, whoſe difference is 20, and the difference of whoſe ſquares is 2000?

20)2000(100 ſum. 50+10=60, the greater; and 50—10=40, the leſs.

Prob. 7. Having the product of two numbers, and one of them given, to find the other.

Rule. Divide the product by the given number, and the quotient will be the number required.

Let the product of two numbers be 288,
nd one of them 8; I demand the other?

8)288
——
Anſ. 36

Prob. 8. Having the dividend and quotient, to find
ıe diviſor.

Rule. Divide the dividend by the quotient.

Cor. Hence we get another method of proving Di-
iſion.

Given { 288 the dividend.
Given { 36 the quotient,
Required the diviſor.

36)288(8 diviſor.
288
——

Prob. 9. Having the diviſor and quotient given, to
nd the dividend.

Rule. Multiply them together.

Given { 8 the diviſor.
Given { 36 the quotient.
Required the dividend.

36
8
——
288 the dividend.

By a due conſideration and application of theſe Prob-
ns only, many queſtions may be reſolved in a ſhort and
egant manner, although ſome of them are generally
ppoſed to belong to higher rules.

APPLICATION OF THE PRECEDING RULES.

1. The leaſt of two numbers is 19418, and the dif-
ence between them is 238: What is the greater, and
m of both?
19418+2384=21802, greater; and 19418+21802
41220, ſum.

2. Suppoſe a man born in the year 1743: When
ll he be 57 years of age?
1743+57=1800, *Anſ.*

What

3. What number is that, which being added to 19418, will make 21802?

21802—19418=2384, *Anſ.*

4. General Waſhington was born in 1732: What was his age in 1787? 1787—1732=55, *Anſ.*

5. America was diſcovered by Columbus in 1492, and its Independence declared in 1776: How many years have elapſed between thoſe two æras?

1776—1492=284, *Anſ.*

6. The Maſſacre at Boſton, by the Britiſh Troops, happened, March 5th, 1770, and the Battle of Lexington, April 19th, 1775: How long between?

April 19, 1775—March 5, 1770=5y. 1m. 14d. *Anſ.*

7. General Burgoyne and his army were captured October 17th, 1777, and Earl Cornwallis and his army, October 19th, 1781: What ſpace of time between?

October 19, 1781—October 17, 1777=4 years and 2 days, *Anſ.*

8. The war between America and England commenced April 19th, 1775, and a general peace took place January 20th, 1783: How long did the war continue?

Jan. 20, 1783—April 19, 1775=7y. 9m. 1d. *Anſ.*

9. A, B, C, and D, purchaſed a quantity of goods in partnerſhip; A paid £12 10s. a dollar, and a crown piece; B, 35s.; C, 29s. 10d.; and D, 79d.: What did the goods coſt? *Anſ.* £16 14s. 1d.

10. A man borrowed, at different times, theſe ſeveral ſums, viz. £29 5s. £18 17s. 6d. £45 12s. £98, 3 dollars, one crown piece and a half: Pray how much was he in debt? *Anſ.* £193 2s. 6d.

11. There are 4 numbers; the firſt 315, the ſecond 912, the third 1229, and the fourth as much as the other three, abating 97: What is the ſum of them all?
Anſ. 4819.

12. Bought a quantity of goods for £125 10s. paid for truckage 45s. for freight 79s. 6d. for duties 35s. 10d. and my expenſes were 53s. 9d.: What did the goods ſtand me in? *Anſ.* £136 4s. 1d.

13. A gentleman left his ſon £1725 more than his daughter, whoſe fortune was 15 thouſand 15 hundred and 15 pounds: What was the ſon's portion, and what did the whole eſtate amount to?

Anſ. The ſon's fortune £18240, and the whole eſtate £34755.

14. A merchant had 6 debtors, who, together, owed him £4917 10s. 6d. A, B, C, D, and E owed him £1675 13s. 9d. of it: What was F's debt?
Anſ. £1241 16s. 9d.

15. What is the difference between £1309 7s. 1d. and the amount of £345 13s. 4d. and 571l. 4s. 8d.?
Anſ. £392 9s. 1d.

16. A merchant, at his firſt engaging in trade, owed £937 15s.; he had in caſh £1755 3s. 6d. in goods £459 12s. 3d. in good debts £197 16s. and he cleared the firſt year £249 19s. 10d.: What was the neat balance at the year's end? *Anſ.* £1724 16s. 7d.

17. What ſum of money muſt be divided between 12 men, ſo as that each may receive £155?
£155 × 12 = £1860 *Anſ.*

18. What number muſt I multiply by 9, that the product may be 675? 675 ÷ by 9 = 75, *Anſ.*

19. A privateer of 175 men took a prize, which amounted to £59 per man, beſide the owner's half: What was the value of the prize?
175 × 59 × 2 = £20650, *Anſ.*

20. What is the difference between thrice five, and thirty; and thrice thirty-five?

$35\times3-\overline{5\times3\quad30}=60$, *Anſ.*

21. The ſum of two numbers is 750; the leſs 248: What is the difference, product, and the ſquare of their difference?*

$750-248=502$ the greater number, $502-248=254$ difference, $502\times248=124496$ product, and $254\times254=64516$ ſquare of the difference.

22. What is the difference between ſix dozen dozen, and a half a dozen dozen; and what is their product, and the quotient of the greater by the leſs?

Anſ. $\overline{6\times12\times12}-\overline{6\times12}=792$ diff. $6\times12\times12\times6\times12=62208$ product, and $6\times12\times12\div\overline{6\times12}=12$, Quotient.

23. There are two numbers; the greater of them is 25 times 78, and their difference is 9 times 15; their ſum and product are required.

Anſ. $78\times25=1950$ the greater, $1950-\overline{15\times9}=1815$ the leſs. $1950+1815=3765$ the ſum, and $1950\times1815=3539250$ the product.

24. A Merchant began trade with £25127; for 6 years together, he cleared £1253 per annum; the next 5 years, he cleared £1729 per annum; but, the laſt 4 years, had the misfortune to loſe £3019 per annum: What was he worth at the 15 years' end?

Anſ. £29414.

25. If a man ſpends £192 in a year: What is that per Calendar month? $192\div12=$£16 *Anſ.*

---

* A number is ſaid to be ſquared, when it is multiplied into itſelf.

26. If the Federal Debt, which is 42 million dollars, be equally divided between the 13 States: What will be the ſhare of each? *Anſ.* $3230769\frac{3}{13}$ dollars.

27. If 9000 men march in a column of 750 deep: How many march abreaſt? $9000 \div 750 = 12$, *Anſ.*

28. What number, deducted from the 32d part of 3072, will leave the 96th part of the ſame?

$\overline{3072 \div 32} - 32 = 64$, *Anſ.*

29. What number is that, which, multiplied by 3589, will produce 92050672?

$92050672 \div 3589 = 25648$, *Anſ.*

30. Suppoſe the quotient ariſing from the diviſion of two numbers to be 5379, the diviſor 37625: What is the dividend, if the remainder come out 9357?

$37625 \times 5379 + 9357 = 202394232$, *Anſ.*

REDUCTION

Teaches to bring, or exchange, numbers of one denomination, to others, of different denominations, retaining the ſame value.

It is of *two* ſorts, viz. Deſcending and Aſcending; the former of which is performed by Multiplication, and the latter by Diviſion.

REDUCTION DESCENDING.

RULE.

Multiply the higheſt denomination, given, by ſo many of the next leſs, as make one of that greater, and thus continue, till you have brought it down as low as your queſtion requires.

PROOF. Change the order of the queſtion, and divide your laſt product by the laſt multiplier, and ſo on.

EXAMPLES.

EXAMPLES.

1. In £27 15s. 9d. 2qr. how many farthings?

£	s.	d.	qr.
27	15	9	2

Multiplied by 20=Shillings in a pound.

555=Shillings.
—— by 12=Pence in a ſhilling.

6669=Pence.
—— by 4=Farthings in a penny.

Anſ. =26678 Farthings.

Note. In multiplying by 20, I added in the 15s.—by 12, the 9d. and by 4, the 2qrs. which muſt always be done in like caſes.

To prove the above queſtion, change the order of it, and it will ſtand thus: In 26678 farthings, how many pounds.

4)26678

12)6669 2qrs.

2|0)555|5 9d.

Anſwer, £27 15 9 2

2. In £36 12s. 10d. 1qr. how many farthings?
Anſ. 35177.

3. In £95 11s. 5d. 3qrs. how many farthings?
Anſ. 91751.

4. In £719 9s. 11d. how many half pence?
Anſ. 345358.

5. In 29 guineas, at 28s. how many pence?
Anſ. 9744.

6. In 37 piſtoles, at 22s. how many ſhillings, pence and farthings?

Anſ. 814s. 9768d. 39072 farthings.

7. In 49 half johannes, at 48s. how many ſixpences?

Anſ. 4704.

8. In 473 French crowns, at 6s. 8d. how many threepences? *Anſ.* 12613$\frac{1}{3}$.

9. In 53 moidores, at 36s. how many ſhillings, pence and farthings?

Anſ. 1908s. 22896d. 91584qrs.

10. In £29 how many groats, threepences, pence and farthings?

Anſ. 1740 groats, 2320 threepences, 6960d. 27840qrs.

11. Reduce 47 guineas and one fourth of a guinea into ſhillings, ſixpences, groats, threepences, twopences, pence and farthings.

Anſ. 1323 ſhillings, 2646 ſixpences, 3969 groats, 5292 threepences, 7938 twopences, 15876 pence, and 63504 farthings.

REDUCTION ASCENDING.

RULE.

Divide the loweſt denomination given, by ſo many of that name, as make one of the next higher, and thus continue, till you have brought it into that denomination which your queſtion requires.

EXAMPLES.

1. In 547325 farthings how many pence, ſhillings and pounds?

Farthings in a penny = 4)547325

Pence in a ſhilling = 12)136831 1qr.

Shillings in a pound = 2|0)1140|2 7d.

£570 2s. 7d. 1qr.

Anſ. 136831d. 11402s. and £570.

Note. The remainder is always of the ſame name as the dividend.

2. Bring 35177 farthings into pounds.

3. Bring 91751 farthings into pence, &c.

4. Bring 345358 half pence into pence, ſhillings and pounds.

5. Reduce 9744 pence to guineas, at 28s. per guinea.

6. In 39072 farthings, how many piſtoles, at 22s. ?

7. In 4704 ſixpences, how many half johannes ?

8. In 12613⅓, threepences, how many French crowns, at 6s. 8d. ?

9. In 91584 farthings, how many moidores, at 36s. ?

10. In 27840 farthings, how many pence, threepences, groats, ſhillings and pounds ?

11. In 63504 farthings, how many pence, twopences, threepences, groats, ſixpences, ſhillings and guineas ?

Note. The preceding queſtions may ſerve as proofs to thoſe in Reduction deſcending.

REDUCTION DESCENDING AND ASCENDING.

1. MONEY.

1. In £97 how many pence, and Engliſh or French crowns, at 6s. 8d. ?

Anſ. 23280d. and 291 crowns.

2. In 947 Engliſh crowns, at 6s. 8d. how many ſhillings, and Engliſh guineas ?

Anſ. 6313s. 4d. and 225 guin. 13s. 4d.

3. In 519 Engliſh half crowns, how many pence and pounds? *Anſ.* 20760d. and £86 10s.

4. In 1259 groats, how many farthings, pence, ſhillings and guineas?

Anſ. 20144qrs. 5036d. 419s. 8d. and 14 guineas, 27s. 8d.

5. In 75 piſtoles, how many pounds?
Anſ. £82 10s.

6. In 735 French crowns, how many ſhillings and French guineas, at 26s. 8d.?
Anſ. 4900s. and 183 guineas, 20s.

7. In 5793 pence, how many farthings, pounds and piſtoles?
Anſ. 23172qrs. £24 2s. 9d. and 21 piſtoles, 20s. 9d.

8. In £99 how many ſhillings, and half johannes, at 48s.? *Anſ.* 1980s. and 41 half joes, 12s.

9. In £179 how many guineas?
Anſ. 127 guineas, 24s.

10. In £345 how many moidores?
Anſ. 191 moidores, 24s.

11. In 59 half joes, 37 moidores, 45 guineas, 63 piſtoles, 24 Engliſh crowns, and 19 dollars; how many pounds, half joes, moidores, guineas, piſtoles, Engliſh crowns, dollars, ſhillings, pence, and farthings?

Anſ. £354 4s. 147 half joes, 28s. 196 moidores, 28s. 253 guineas, 322 piſtoles, 1062 Engliſh crowns, 4s. 1180 dollars, 4s. 7084 ſhillings, 85008d. and 340032qrs.

When it is required to know how many ſorts of coin, of different values, and of equal number, are contained in any number of another kind; reduce the ſeveral ſorts of coin into the loweſt denomination mentioned, and add them together for a diviſor; then, reduce the money given, into the ſame denomination for a dividend, and the quotient ariſing from the diviſion, will be the number required.

Note. Obſerve the ſame direction in weights and meaſures.

1. In 275 half johannes, how many moidores, guineas, piſtoles, dollars, ſhillings and ſixpences, of each, the like number?

A moid. is 36s. that is } 72 ſixpences.
A guin. is 28s. that is } 56 ditto.
A piſtole is 22s. that is } 44 ditto.
A dollar is 6s. that is } 12 do.
One ſhilling has 2
1

Diviſor = 187 ſixpences.

275 half joes.
48 ſhill. in a johan.
2200
1100
13200 ſhillings.
2 ſixp. in a ſhill.
Div.=26400 ſixpences.

187)26400(141 of each, and 33 ſixpences, or 16s. 6d. over the *Anſwer.*

2. A gentleman diſtributed £37 10s. between 4 perſons in the following manner, viz. that as often as the firſt had 20s. the ſecond ſhould have 15s. the third, 10s. and the fourth, 5s. What did each perſon receive?

Anſ. the firſt man £15.

2. TROY WEIGHT.

1. How many grs. in a ſilver bowl, that weighs 3lb. 10oz. 12pwts.?

lb. oz. pwt.
3 10 12
12 ounces in a pound.
—
46 ounces.
20 pennyweights in one ounce.
—
932 pennyweights.
24 grains in one pwt.
—
3728
1864
—
Proof. 24)22368 grains, *Anſwer.*
—
2|0)93|2
12)46 12pwt.
—
lb 3 10oz.

2. In 487oz. how many pwts. and grs.?
Anſ. 9740pwts. 233760grs.

3. In 13 ingots of gold, each weighing 9oz. 5pwts. how many grains? *Anſ.* 57720gr.

4. In 97397grs. how many pounds?
Anſ. 16lb. 10oz. 18pwt. 5gr.

5. How many rings, each weighing 5pwt. 7gr. may be made of 3lb. 5oz. 16pwt. 2gr. of gold?
Anſ. 158.

3. AVOIRDUPOIS

3. AVOIRDUPOIS WEIGHT.

Cwt. qr. lb. oz.
1. In 91 3 17 14 how many ounces?
4
367 quarters.
28
2943
735
10293 pounds.
16
61762
10294
164702 ounces.

Proof.
16)164702
28)10293 14oz.
4)367 17lb.
Cwt. 91 3qrs.

2. In 12 tons, 15cwt. 1qr. 19lb. 6oz. 12dr. how many drams?

Anſ. 7223500dr.

3. In 24lb. 11oz. 9dr. how many drams?

Anſ. 6329dr.

4. In 44800 pounds, how many drams and tons?

Anſ. 11468800dr. and 20 tons.

5. In 28lb. Avoirdupois, how many pounds Troy?

lb
28
7000 grains, in 1lb. Avoirdupois.
———
grs. in 1lb. tr. } =596|0)19600|0(34lb.
1728
———
2320
2304
———
160
12
———
576|0)192|0(0oz.
20
———
576|0)384|00(6pwts.
3456
———
3840
24
———
1536
768
———
576|0)921|6|0(16gr.
576
———
3456
3456
———

6. In 47lb. 9oz. 13pwt. 17grs. Troy, how many lb. Avoirdupois?

lb	oz	pwt.	gr.
47	9	13	17

12
———
572
20
———
11473
24
———
45899
22947
———
7|000)275|369(39lb.
21
———
65
63
———
2369
16
———
14214
2369
———
7|000)37|904(5oz.

Carried over.

Brought over 7|000)37|904(5oz.
35
2904
16
17424
2904
7|000)46|464($1\frac{4464}{7000}$dr.
42
4464

4. APOTHECARIES' WEIGHT.

1. How many grains are there in 37℔ 6℥ ?

℔ ℥
37 6
12
450 ounces.
8
3600 drams.
3
10800 ſcruples.
20
216000 grains.

Proof.
2|0)21600|0
3)10800
8)3600
12)450
37℔ 6℥

2. In 9℔ 8℥ 1ʒ 2℈ 19gr. how many grains?
Anſ. 55799gr.

3. In 55799 grains, how many pounds, &c?
Anſ. 9℔ 8℥ 1ʒ 2℈ 19gr.

5. CLOTH

5. CLOTH MEASURE.

1. In 127 yards, how many quarters and nails?

Yds.	
127	
4	Proof.
——	4)2032
508qrs.	——
4	4)508
——	——
Anſ. 2032 nails.	127 yards.

2. In 9173 nails, how many yards?
Anſ. 573yds. 1qr. 1n.

3. In 75 ells Engliſh, how many quarters and nails?
Anſ. 375qrs. 1500n.

4. In 56 ells Flemiſh, how many quarters and nails?
Anſ. 168qrs. 672n.

5. In 39 ells French, how many quarters and nails?
Anſ. 234qrs. 936n.

6. In 7248 nails, how many yards, ells Flemiſh, ells Engliſh and ells French?
Anſ. 453yds. 604 ells Flem. 362 ells Eng. 2qrs. 302 ells French.

7. In 19 pieces of cloth, each 15 yards 2 quarters, how many yards, quarters and nails?
Anſ. 294yds. 2qrs. 1178qrs. & 4712n.

6. Long Measure.

1. How many barley corns will reach from Newburyport to Boſton, it being 43 miles?

Miles.	Proof.
43	
8	3)8173440
344 furlongs.	12)2724480
40	3)227040
13760 rods.	
5½	11)75680
68800	6880
6880	2
75680 yards.	4|0)1376|0
3	8)344
227040 feet.	
12	43
2724480 inches.	
3	
8173440 *Anſwer.*	

Here I divide by 11, and multiply the quotient by 2, becauſe twice 5½ is 11,—or I might firſt have multiplied by 2, and then, have divided the product by 11.

2. How many barley corns will reach round the globe, it being 360 degrees? *Anſ.* 4755801600.

3. How many inches from Newburyport to London, it being 2700 miles? *Anſ.* 171072000.

4. How often will a wheel, of 16 feet and 6 inches circumference, turn round in the diſtance from Newbury-port to Cambridge, it being 42 miles?

Anſ. 13440 times.

5. In 190080 inches, how many yards and leagues?

Anſ. 5280yds. and 1 league.

7. Time.

1. In 20 years, how many ſeconds?

d. h.
365 6 in a year.
24
1466
730
8766 hours in one year.
20
175320 hours in 20 years.
60
10519200 minutes in ditto.
60
631152000 ſeconds in ditto.

Proof.
6|0)63115200|0
6|0)1051920|0
2|0)17532|0
4×6)8766
4)1461
365d. 6h.

2. Suppoſe your age to be 15y. 19d. 11h. 37m. 45s. how many ſeconds are there in it, allowing 365 days and 6 hours to the year? *Anſ.* 475047465.

3. How many minutes from the firſt day of January to the 14th day of Auguſt, incluſively?

Anſ. 325440.

4. How many days ſince the commencement of the Chriſtian Æra?

5. How many minutes ſince the commencement of the American war, which happened on the 19th day of April, 1775?

6. How many ſeconds between the commencement of the war, April 19th, 1775, and the Independence of the United States of America, which took place the 4th day of July, 1776? *Anſ.* 38102400.

8. LAND or SQUARE MEASURE.

1. In 29 acres, 3 roods, 19 poles, how many roods and perches?

Acr. r. p.
29 3 19
4
119 roods.
40
Anſ. 4779 perches.

Proof.
4|0)477|9
4)119—19p.
29ac.—3r.

2. In 1997 poles, how many acres? *Anſ.* 12a. 1r. 37p.

9. SOLID MEASURE.

1. In 15 tons of hewn timber, how many ſolid inches?

15 tons.
50
750 feet.
1728
6000
1500
5250
750
Anſ. 1296000 inches.

Proof.
5|0
1728)1296000(75|0
12096
15 Tons.
8640
8640

2. In 9 tons of round timber, how many inches?
Anſ. 622080.

10. Wine Measure.

1. In 9hhds. 15gal. 3qts. of wine, how many quarts?

hhds. gal. qts.
9 15 3
63
—
32
55
—
582 gallons.
4
—
Anſ. 2331 quarts.

Proof.
4)2331
—
63)582—3qts.
—
9hhds.—15g.

2. In 12 pipes of wine, how many pints?
Anſ. 12096.

3. In 9758 pints of brandy, how many pipes?
Anſ. 9p. 1hhd. 22gal. 3qts.

4. In 1008 quarts of cider, how many tuns?
Anſ. 1 tun.

11. Ale or Beer Measure.

1. In 29hhds. of beer, how many pints?

hhds.
29
54
—
116
145
—
1566 gallons.
4
—
6264 quarts.
2
—
Anſ. 12528 pints.

Proof.
2)12528
—
4)6264
—
54)1566
—
29hhds.

2. In

2. In 47bar. 18gal. of ale, how many pints?
Anſ. 12928.

3. In 36 puncheons of beer, how many butts?
Anſ. 24.

12. DRY MEASURE.

1. In 42 chaldrons of coals, how many pecks?

Chaldrons.	Proof.
42	4)5376
32	32)1344(42
	128
84	
126	64
	64
1344 buſhels.	
4	

Anſ. 5376 pecks.

2. In 75 buſhels of corn, how many pints?
Anſ. 4800.

3. In 9376 quarts, how many buſhels?
Anſ. 293.

VULGAR FRACTIONS.

Fractions, or broken numbers, are expreſſions for any aſſignable parts of a unit, or whole number; and are repreſented by two numbers, placed one above another, with a line drawn between them, thus, $\frac{5}{8}$, $\frac{4}{3}$, &c. ſignifying five eighths, four thirds, that is, one and one third, &c.

The figure, above the line, is called the *numerator*, and that below it, the *denominator*.

The denominator (which is the diviſor in diviſion) ſhows how many parts the integer is divided into; and the numerator (which is the remainder after diviſion) ſhows how many of thoſe parts are meant by the fraction.

Fractions are either proper, improper, ſingle, compound, or mixed. Any whole number may be made an improper fraction, by drawing a line under it, and putting unity, or 1 for a denominator, as 9 may be expreſſed fractionwiſe, thus, $\frac{9}{1}$, and 12 thus, $\frac{12}{1}$, &c.

1. A *ſingle*, *ſimple*, or *proper fraction* is, when the numerator is leſs than the denominator, as $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{19}{35}$, &c. and is a ſimple expreſſion for any number of parts of the integer.

2. An *improper fraction* is, when the numerator exceeds the denominator, as $\frac{5}{3}$, $\frac{8}{5}$, $\frac{12}{4}$, &c.

3. A *compound fraction* is the fraction of a fraction, coupled by the word *of*, thus, $\frac{2}{3}$ of $\frac{3}{4}$, $\frac{1}{2}$ of $\frac{3}{5}$ of $\frac{7}{8}$, &c. which are read thus, two thirds of three fourths; one half of three fifths of ſeven eighths.

4. A *mixed number* is compoſed of a whole number and a fraction, as $7\frac{3}{5}$, $35\frac{4}{13}$, &c. that is, ſeven and three fifths, &c.

5. A fraction is ſaid to be in its leaſt, or loweſt terms, when it is expreſſed by the leaſt numbers poſſible.

6. The *common meaſure* of two, or more, numbers, is that number which will divide each of them, without a remainder: Thus, 5 is the common meaſure of 10, 20 and 30; and the *greateſt* number, which will do this, is called the *greateſt common meaſure*.

7. A number, which can be meaſured by two, or more numbers, is called their *common multiple*; and, if it be the leaſt number, which can be ſo meaſured, it is called the *leaſt common multiple*; thus, 40, 60, 80, 100 are multiples of 4 and 5; but their leaſt common multiple is 20.

8. A *prime number* is that, which can only be meaſured by itſelf, or a unit.

9. That number which is produced by multiplying ſeveral numbers together is called a *compoſite number.*

10. A *perfect number* is equal to the ſum of all its aliquot parts.

PROBLEM I.

To find the greateſt common meaſure of two, or more, numbers.

RULE.

1. If there be two numbers only, divide the greater by the leſs, and this diviſor by the remainder, and ſo on, always dividing the laſt diviſor by the laſt remainder, till nothing remain, then will the laſt diviſor be the greateſt common meaſure required.

2. When there are more than two numbers, find the greateſt common meaſure of two of them, as before; then of *that* common meaſure and one of the other numbers, and ſo on, through all the numbers to the laſt; then will the greateſt common meaſure, laſt found, be the anſwer.

3. If 1 happens to be the common meaſure, the given numbers are prime to each other, and found to be incommenſurable, or in their loweſt terms.

EXAMPLES.

EXAMPLES.

1. What is the greateſt common meaſure of 1836, 3996, and 1044?

1836)3996(2
3672
——
324)1836(5
1620
——
216)324(1
216
——
Com. meaſ = 108)216(2
216
——

So 108 is the greateſt common meaſure of 3996 and 1836;
Hence 108)1044(9
972
——
72)108(1
72
——
Laſt gr. com. meaſ. = 36)72(2
72
——

Therefore, 36 is the anſwer required.

2. What is the greateſt common meaſure of 1224 and 1080? *Anſ.* 72.

PROBLEM II.

To find the leaſt common multiple of two, or more, numbers.

RULE.

1. Divide by any number, that will divide two or more of the given numbers, without a remainder, and ſet the quotients, together with the undivided numbers, in a line beneath.

2 Divide the ſecond line, as before, and ſo on, till there are no two numbers, that can be divided; then, the continued product of the diviſors and quotients, will give the multiple required.

EXAMPLES.

EXAMPLES.

1. What is the leaſt common multiple of 6, 10, 16 and 20?

*5)6 10 16 20

*2)6 2 16 4

*2)3 1 8 2

*3 1 *4 1

* * * * *

5 × 2 × 2 × 3 × 4 = 240 *Anſ.*

I ſurvey my given numbers and find that five will divide two of them, viz. 10 and 20, which I divide by 5, bringing, into a line with the quotients, the numbers, which 5 will not meaſure: Again, I view the numbers in the ſecond line, and find 2 will meaſure them all, and I get 3, 1, 8, 2, in the third line, and find that 2 will meaſure 8 and 2, and in the fourth line, get 3, 1, 4, 1, all prime, I then multiply the prime numbers and the diviſors continually into each other, for the number ſought, and find it to be 240.

2. What is the leaſt common multiple of 6 and 8? *Anſ.* 24.

3. What is the leaſt number that 3, 5, 8 and 10 will meaſure? *Anſ.* 120.

4. What is the leaſt number which can be divided by the 9 digits, ſeparately, without a remainder? *Anſ.* 2520.

REDUCTION OF VULGAR FRACTIONS

Is the bringing of them out of one form into another, in order to prepare them for the operations of Addition, Subtraction, &c.

CASE I.*

To abbreviate, or reduce fractions to their loweſt terms.

RULE.

Divide the terms of the given fraction by any number, which will divide them without a remainder, and the quotients, again, in the ſame manner; and ſo on, till it appears that there is no number greater than 1, which will divide them, and the fraction will be in its loweſt terms. *Or*,

---

* That dividing both the terms, that is, both numerator and denominator of the fraction, equally by any number whatever, will give another fraction, equal to the former, is evident: And if thoſe diviſions be performed as often as can be done, or the common diviſor be the greateſt poſſible, the terms of the reſulting fraction muſt be the leaſt poſſible.

NOTE 1. Any number, ending with an even number or cypher, is diviſible by 2.

2. Any number, ending with 5 or 0, is diviſible by 5.

3. If the right hand place of any number be 0, the whole is diviſible by 10.

4. If the two right hand figures of any number be diviſible by 4, the whole is diviſible by 4.

5. If the three right hand figures of any number be diviſible by 8, the whole is diviſible by 8.

6. If the ſum of the digits, conſtituting any number, be diviſible by 3 or 9, the whole is diviſible by 3 or 9.

7. If a number cannot be divided by ſome number leſs than the ſquare root thereof, that number is a *prime.*

8. All *prime* numbers, except 2 and 5, have 1, 3, 7, or 9 in the place of units; and all other numbers are *compoſite.*

9. When numbers, with the ſign of Addition or Subtraction between them, are to be divided by any number, each of the numbers muſt be divided: Thus, $\frac{6+9+12}{3}=2+3+4=9$.

10. But if the numbers have the ſign of Multiplication between them; then only one of them muſt be divided: Thus, $\frac{4\times6\times10}{2\times5}=\frac{2\times6\times10}{1\times5}=\frac{2\times6\times2}{1\times1}=\frac{24}{1}=24$.

Divide both the terms of the fraction by their greateſt common meaſure, and the quotients will be the terms of the fraction required.

EXAMPLES.

1. Reduce $\frac{288}{480}$ to its loweſt terms.

$8\Big\}\ \frac{288}{480}\overset{(4)}{=}\frac{36}{60}\overset{(3)}{=}\frac{9}{15}=\frac{3}{5}$ *the anſwer.*

Or thus:

```
288)480(1
    288
    ---
    192)288(1
        192
        ---
Com.meaſ. 96)192(2
             192
             ---
```

Therefore 96 is the greateſt common meaſure;

and $96\Big\}\ \frac{288}{480}=\frac{3}{5}$ the ſame as before.

2. Reduce $\frac{57}{456}$ to its loweſt terms. *Anſ.* $\frac{1}{8}$.
3. Reduce $\frac{46}{184}$ to its loweſt terms. *Anſ.* $\frac{1}{4}$.
4. Reduce $\frac{14279}{28558}$ to its loweſt terms. *Anſ.* $\frac{1}{2}$.

CASE II.

To reduce a mixed number to its equivalent improper Fraction.

RULE.*

Multiply the whole number by the denominator of the fraction, and add the numerator of the fraction to the product; under which ſubjoin the denominator, and it will form the fraction required.

EXAMPLES.

---

* All fractions repreſent a diviſion of a numerator by the denominator, and are taken altogether as proper and adequate expreſſions of the quotient. Thus the quotient of 3, divided by 4, is $\frac{3}{4}$.

EXAMPLES.

1. Reduce $36\frac{5}{8}$ to its equivalent improper fraction.

$$\begin{array}{r} 36 \\ 8+5 \\ \hline \text{Anſ. } 293 \\ \hline 8 \\ \hline \end{array}$$

I multiply 36 by 8, and adding the numerator 5 to the product, as I multiply, the ſum, 293 is the numerator of the fraction ſought, and 8 the denominator: So that $\frac{293}{8}$ is the improper fraction, equal to $36\frac{5}{8}$.

Or, $\frac{36\times8+5}{8}=\frac{293}{8}$ *Anſwer* as before.

2. Reduce $127\frac{4}{17}$ to its equivalent improper fraction. *Anſ.* $\frac{2163}{17}$.

3. Reduce $653\frac{3}{19}$ to its equivalent improper fraction. *Anſ.* $\frac{12410}{19}$.

CASE III.

To reduce a whole number to an equivalent fraction, having a given denominator.

RULE.

Multiply the whole number by the given denominator: Place the product over the ſaid denominator, and it will form the fraction required.

EXAMPLES.

1. Reduce 6 to a fraction, whoſe denominator ſhall be 8.

$6\times8=48$, and $\frac{48}{8}$ the *Anſ.*—Proof $\frac{48}{8}=48\div8=6$.

2. Reduce 15 to a fraction, whoſe denominator ſhall be 12. *Anſ.* $\frac{180}{12}$.

CASE IV.

To reduce an improper fraction to its equivalent whole, or mixed number.

RULE.*

Divide the numerator by the denominator; the quotient will be the whole number, and the remainder, if any, will be the numerator to the given denominator.

EXAMPLE

1. Reduce $\frac{293}{8}$ to its equivalent whole, or mixed number.

```
8)293(36⅝ Anſ.
  24
  ——
   53
   48
   ——      Or, 293/8=293÷8=36⅝ as before.
    5
```

2. Reduce $\frac{2163}{17}$ to its equivalent whole, or mixed number. *Anſ.* $127\frac{4}{17}$.

3. Reduce $\frac{45}{5}$ to its equivalent whole number. *Anſ.* 9.

CASE V.

To reduce a compound fraction to an equivalent ſimple one.

RULE.

Multiply all the numerators continually together for a new numerator, and all the denominators, for a new denominator, and they will form the ſimple fraction required.

---

* This rule is evidently the reverſe of Caſe 2d.

If part of the compound fraction be a whole or mixed number, it muſt be reduced to an improper fraction, by caſe 2d, or 3d.

If the denominator of any member of a compound fraction be equal to the numerator of another member thereof, theſe equal numerators and denominators may be expunged, and the other members continually multiplied, (as by the rule) will produce the fractions required in lower terms.

EXAMPLES.

1. Reduce $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ to a ſimple fraction.

$$\frac{1\times2\times3\times4}{2\times3\times4\times5}=\frac{24}{120}=\frac{1}{5}$$ the *Anſwer.*

Or, by expunging the equal numerators and denominators, it will give $\frac{1}{5}$ as before.

2. Reduce $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$ of $\frac{11}{12}$ to a ſimple fraction.

$\frac{3\times4\times5\times11}{4\times5\times6\times12}=\frac{660}{1440}=\frac{11}{24}$ *Anſ.* Or, by expunging the equal numerators and denominators, it will be $\frac{3\times11}{6\times12}=\frac{33}{72}=\frac{11}{24}$ as before.

CASE VI.

To reduce fractions of different denominators, to equivalent fractions, having a common denominator.

RULE I.

Multiply each numerator into all the denominators, except its own, for a new numerator, and all the denominators into each other, continually, for a common denominator.

EXAMPLES.

1. Reduce $\frac{1}{4}$, $\frac{2}{5}$ and $\frac{5}{8}$ to equivalent fractions, having a common denominator.

$1 \times 5 \times 8 = 40$ the new numerator for $\frac{1}{4}$.
$2 \times 4 \times 8 = 64$ ditto for $\frac{2}{5}$.
$5 \times 4 \times 5 = 100$ ditto for $\frac{5}{8}$.
$4 \times 5 \times 8 = 160$ the common denominator.

Therefore the new equivalent fractions are $\frac{40}{160}$, $\frac{64}{160}$ and $\frac{100}{160}$, the *Anſ.*

2. Reduce $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$ and $\frac{7}{8}$ to fractions having a common denominator.

Anſ. $\frac{576}{1152}$, $\frac{768}{1152}$, $\frac{864}{1152}$, $\frac{960}{1152}$, $\frac{1008}{1152}$.

3. Reduce $\frac{1}{2}$, $\frac{2}{3}$ of $\frac{5}{6}$, $7\frac{3}{4}$, and $\frac{3}{13}$, to a common denominator.

Anſ. $\frac{936}{1872}$, $\frac{1040}{1872}$, $\frac{14508}{1872}$, $\frac{432}{1872}$.

RULE II.

To reduce any given fractions to others, which ſhall have the leaſt common denominator.

1. By Prob. 2, page 70, find the leaſt common multiple of all the denominators of the given fractions, and it will be the common denominator required.

2. Divide the common denominator by the denominator of each fraction, and multiply the quotient by the numerator, and the product will be the numerator of the fraction required.

EXAMPLES.

EXAMPLE.

Reduce $\frac{1}{3}$, $\frac{3}{4}$ and $\frac{7}{8}$ to fractions, having the leaſt common denominator poſſible.

$$\begin{array}{l} 4)\underline{3\quad4\quad8} \\ \quad\;\underline{3\quad1\quad2} \end{array}$$

$4\times3\times2=24=$ leaſt common denominator.

$\overline{24\div3}\times1=8$ the firſt numerator; $\overline{24\div4}\times3=18$ the ſecond numerator; $\overline{24\div8}\times7=21$ the third numerator.

Whence, the required fractions are $\frac{8}{24}$, $\frac{18}{24}$, $\frac{21}{24}$.

CASE VII.

To reduce a fraction of one denomination to the fraction of another, but greater, retaining the ſame value.

RULE.

Reduce the given fraction to a compound one by comparing it with all the denominations, between *it* and *that* denomination you would reduce it to; laſtly, reduce this compound fraction to a ſingle one, by caſe 5th, and you will have a fraction of the required denomination, equal in value to the given fraction.

EXAMPLES.

1. Reduce $\frac{3}{5}$ of a penny to the fraction of a pound.

By comparing it, it becomes $\frac{3}{5}$ of $\frac{1}{12}$ of $\frac{1}{20}$; which, reduced by caſe 5th, will be $\underline{3\times1\times1=3}$.

And $5\times12\times20=1200=\frac{1}{400}$.

2. Reduce $\frac{3}{4}$ of a farthing to the fraction of a pound. *Anſ.* £$\frac{1}{1280}$.

3. Reduce $\frac{5}{8}$ of a penny to the fraction of a guinea. *Anſ.* $\frac{5}{2588}$ guinea.

4. Reduce $\frac{12}{19}$ of a ſhilling to the fraction of a moidore. *Anſ.* $\frac{1}{57}$ moidore.

5. Reduce $\frac{4}{7}$ of an ounce to the fraction of a ℔ Avoirdupois. *Anſ.* $\frac{1}{28}$ ℔.

6. Reduce 3s. 6d. to the fraction of a pound. *Anſ.* £$\frac{7}{40}$.

7. Reduce 13s. 6d. to the fraction of a piſtole. *Anſ.* $\frac{27}{44}$ piſtole.

8. *Reduce $\frac{4}{5}$ of a pound to the fraction of a guinea. *Anſ.* $\frac{4}{7}$ guinea.

9. Reduce $\frac{7}{8}$ of a pwt. to the fraction of a pound Troy. *Anſ.* $\frac{7}{1920}$ lb.

10. Reduce $\frac{8}{9}$ of a lb. Avoirdupois to the fraction of 1 Cwt. *Anſ.* $\frac{1}{126}$ Cwt.

CASE VIII.

To reduce a fraction of one denomination to the fraction of another, but leſs, retaining the ſame value.

RULE.

Multiply the given numerator by the parts of the denominations between *it* and *that* denomination you would reduce it to, for a new numerator, which place over the given denominator: *Or,* only invert the parts contained in the integer, and make of them a compound fraction as before; then, reduce it to a ſimple one.

---

* $\frac{4}{5}$£ $= \frac{4}{5}$ of $\frac{20}{1} = \frac{4 \times 20}{5 \times 1} = \frac{80}{5}$s. and $\frac{80}{5}$ of $\frac{1}{28} = \frac{80 \times 1}{5 \times 28} = \frac{80}{140} = \frac{4}{7}$guin.

EXAMPLES.

1. Reduce $\frac{1}{400}$ of a pound to the fraction of a penny.

By comparing it, the fraction will be $\frac{1}{400}$ of $\frac{20}{1}$ of $\frac{12}{1}$:

then $\left\}\frac{1}{400}\times\frac{20}{1}\times\frac{12}{1}=\frac{240}{400}=\frac{3}{5}\right.$ *Anſwer.*

2. Reduce $\frac{1}{1280}$ of a pound to the fraction of a farthing. *Anſ.* $\frac{3}{4}$qr.

3. Reduce $\frac{5}{2688}$ of a guinea to the fraction of a penny. *Anſ.* $\frac{5}{8}$d.

4. Reduce $\frac{1}{57}$ of a moidore to the fraction of a ſhilling. *Anſ.* $\frac{12}{19}$s.

5. Reduce $\frac{1}{28}$ of a lb Avoirdupois to the fraction of an ounce. *Anſ.* $\frac{4}{7}$oz.

6. *Reduce $\frac{4}{7}$ of a guinea to the fraction of a pound. *Anſ.* $\frac{4}{5}$£.

7. Reduce $\frac{7}{1920}$ of a lb. Troy to the fraction of a pwt. *Anſ.* $\frac{7}{8}$pwt.

8. Reduce $\frac{1}{126}$ of a cwt. to the fraction of a lb. Avoirdupois. *Anſ.* $\frac{8}{9}$lb.

CASE

---

* $\frac{4}{7}$ Guin. $=\frac{4}{7}$ of $\frac{28}{1}=\frac{4\times28}{7+1}=\frac{112}{7}$s. & $\frac{112}{7}$ of $\frac{1}{20}=\frac{112}{140}=\frac{4}{5}$£.

CASE IX.

To find the value of a fraction in the known parts of the integer, as of coin, weight, meaſure, &c.

RULE.

Multiply the numerator by the parts in the next inferior denomination, and divide the product by the denominator; and if any thing remain, multiply it by the next inferior denomination, and divide by the denominator as before, and ſo on, as far as neceſſary; and the quotients placed after one another, in their order, will be the anſwer required.

EXAMPLES.

1. What is the value of $\frac{5}{7}$ of a pound?

5
20
——
7)100
——
14s.—2
12
——
7)24
——
3d.—3
4
——
7)12
——
$1\frac{5}{7}$qr.

I multiply 5 by 20, the number of ſhillings in £1, and the product 100 I divide by the denominator 7, and get the quotient 14s. and 2 remaining, I multiply it by 12, and again dividing the product by 7, find the quotient 3d. and 3 remains, which I multiply by 4, and, dividing as before, the quotient is 1qr. and 5 remaining, I place it over the numerator, and find the anſwer, 14s. 3d. $1\frac{5}{7}$qr.

2. What is the value of $\frac{9}{24}$ of a ſhilling?

Anſ. $4\frac{1}{2}$d.

3. What is the value of $\frac{17}{29}$ of a Cwt.?

Anſ. 2qrs. 9lb. 10oz. $7\frac{21}{29}$dr.

4. What is the value of $\frac{4}{5}$ of a lb. Avoirdupois?

Anſ. 12oz. $12\frac{4}{5}$dr.

5. What is the value of $\frac{3}{5}$ of a lb. Troy?

Anſ. 7oz. 4pwt.

6. What is the value of $\frac{3}{13}$ of a ton?

Anſ. 4Cwt. 2qrs. 12℔. 14oz. $12\frac{4}{13}$dr.

7. What is the value of $\frac{6}{9}$ of a yard?

Anſ. 2qrs. $2\frac{2}{3}$n.

8. What is the value of $\frac{7}{8}$ of an ell Engliſh?

Anſ. 4qrs. $1\frac{1}{2}$n.

9. What is the value of $\frac{5}{6}$ of a mile?

Anſ. 6fur. 26p. 11ft.

10. What is the value of $\frac{9}{13}$ of a day?

Anſ. 16h. 36m. $55\frac{5}{13}$s.

11. The value of $\frac{9}{14}$ of a guinea is demanded.

Anſ. 18s.

12. What is the value of $\frac{15}{16}$ of a dollar?

Anſ. 5s. $7\frac{1}{2}$d.

13. What is the value of $\frac{3}{5}$ of a moidore?

Anſ. 21s. $7\frac{1}{5}$d.

14. What is the value of $\frac{6}{7}$ of an acre?

Anſ. 3r. $17\frac{1}{7}$p.

CASE X.*

To reduce any given quantity to the fraction of any greater denomination of the ſame kind.

RULE.

Reduce the given quantity to the loweſt term mentioned, for a numerator; then reduce the integral part to the ſame term, for a denominator; which will be the fraction required.

EXAMPLES.

1. Reduce 14s. $3\frac{1}{4}$d. $\frac{5}{7}$ to the fraction of a pound.

20 integral part.	s. d.
12	14 $3\frac{1}{4}$, $\frac{5}{7}$
——	12
240	——
4	171
——	4
960	——
7	685
——	7 + 5
6720 denominator.	——
	4800 numerator.
	Anſ. $\frac{4800}{6720}=\frac{5}{7}$£.

2. Reduce $4\frac{1}{2}$d. to the fraction of a ſhilling. *Anſ.* $\frac{3}{8}$s.

3. Reduce 2qrs. 9lb 10oz. $7\frac{21}{29}$dr. to the fraction of a Cwt. *Anſ.* $\frac{17}{29}$Cwt.

---

* This caſe is the reverſe of the former, therefore proves it.

NOTE. If there be a fraction given with the ſaid quantity, it muſt be further reduced to the denominative parts thereof, adding thereto the numerator.

4. Reduce 7oz. 4pwt. to the fraction of a lb. Troy.
Anſ. $\frac{3}{5}$lb.

5. Reduce 2qrs. $2\frac{2}{3}$n. to the fraction of a yard.
Anſ. $\frac{2}{3}$yd.

6. Reduce 18s. to the fraction of a guinea.
Anſ. $\frac{9}{14}$G.

7. Reduce 5s. $7\frac{1}{2}$d. to the fraction of a dollar.
Anſ. $\frac{15}{16}$dol.

8. Reduce 21s. $7\frac{1}{5}$d. to the fraction of a moidore.
Anſ. $\frac{3}{5}$moid.

ADDITION OF VULGAR FRACTIONS.

RULE.

Reduce compound fractions to ſingle ones; mixed numbers to improper fractions; fractions of different integers to thoſe of the ſame; and all of them to a common denominator; then the ſum of the numerators written over the common denominator will be the ſum of the fractions required.

EXAMPLES.

1. Add $7\frac{4}{5}$, $\frac{5}{7}$ of $\frac{3}{8}$, and 7 together.
Firſt. $7\frac{4}{5}=\frac{39}{5}$, $\frac{5}{7}$ of $\frac{3}{8}=\frac{15}{56}$, and $7=\frac{7}{1}$.
Then the fractions are $\frac{39}{5}$, $\frac{15}{56}$; and $\frac{7}{1}$; therefore

$$\begin{array}{r}
39\times56\times\ 1=2184\\
15\times\ 5\times\ 1=\ \ 75\\
7\times\ 5\times56=1960\\
\hline
\dfrac{4219}{5\times56\times1=280}=15\frac{19}{280}
\end{array}$$

Or thus, $\frac{2184+75+1960}{280}=15\frac{19}{280}$.

2. What is the ſum of $\frac{7}{10}$ of $4\frac{5}{8}$, $\frac{3}{4}$ of $\frac{1}{3}$ and $9\frac{1}{4}$?
Anſ. $12\frac{59}{80}$.

3. Add $\frac{1}{9}$l. $\frac{3}{7}$s. and $\frac{4}{5}$d. together.
Anſ. 2s. $8\frac{64}{105}$d.

4. Add $\frac{1}{4}$ of a week, $\frac{1}{3}$ of a day, $\frac{1}{2}$ of an hour, and $\frac{3}{4}$ of a minute together.
Anſ. 2 days, 2 hours, 30 minutes, 45 ſeconds.

SUBTRACTION OF VULGAR FRACTIONS.

RULE.*

Prepare the fractions as in Addition, and the difference of the numerators, written above the common denominator, will give the difference of the fractions required.—*Note*, a fraction is ſubtracted from a whole number, by taking the numerator of the fraction from its denominator, and placing the remainder over the denominator, then taking one from the whole number.

EXAMPLES.

1. From $\frac{3}{4}$ take $\frac{2}{7}$ of $\frac{5}{8}$.

$\frac{2}{7}$ of $\frac{5}{8}=\frac{10}{56}=\frac{5}{28}$. Then the fractions are $\frac{3}{4}$ and $\frac{5}{28}$.

$3\times 28=84$
$5\times 4=20$
$4\times 28=112$ com. den.

$\frac{3}{4}=\frac{84}{112}$, and $\frac{5}{28}=\frac{20}{112}$, therefore, $\frac{84}{112}-\frac{20}{112}=\frac{64}{112}=\frac{4}{7}$ remainder.

---

* In ſubtracting mixed numbers, when the lower fraction (the ſubtrahend) is greater than the upper one, (the minuend) you may, without reducing them to improper fractions, ſubtract the numerator of the ſubtrahend from the common denominator, and to that difference add the numerator of the minuend, and carry one to the integer of the ſubtrahend.

EXAMPLE.

From $19\frac{3}{8}$ take $12\frac{7}{8}$.——$19\frac{3}{8}-12\frac{7}{8}=6\frac{1}{2}$.

2. From $\frac{49}{50}$ take $\frac{5}{9}$. *Anſ.* $\frac{191}{450}$.

3. From $37\frac{1}{4}$ take $19\frac{4}{7}$. *Anſ.* $17\frac{19}{28}$.

4. From $13\frac{1}{3}$ take $\frac{3}{4}$ of 15. *Anſ.* $2\frac{1}{12}$.

5. From £$\frac{1}{4}$ take $\frac{9}{10}$s. *Anſ.* 4s. $1\frac{1}{5}$d.

6. From $\frac{5}{7}$oz. take $\frac{3}{4}$pwt. *Anſ.* 13pwt. $12\frac{6}{7}$gr.

MULTIPLICATION OF VULGAR FRACTIONS.

RULE.

Reduce compound fractions to ſimple ones, and mixed numbers to improper fractions; then the product of the numerators will be the numerator, and the product of the denominators, the denominator of the product required. —*Note*, where ſeveral fractions are to be multiplied, if the numerator of one fraction be equal to the denominator of another, their equal numerators and denominators may be omitted.

EXAMPLES.

1. What is the continued product of $4\frac{1}{3}$, $\frac{1}{5}$, $\frac{1}{4}$ of $\frac{7}{8}$, and 6?

$4\frac{1}{3}=\frac{13}{3}$, $\frac{1}{4}$ of $\frac{7}{8}=\frac{1\times7}{4\times8}=\frac{7}{32}$, and $6=\frac{6}{1}$.

Then $\frac{13}{3}\times\frac{1}{5}\times\frac{7}{32}\times\frac{6}{1}=\frac{13\times1\times7\times6}{3\times5\times32\times1}=\frac{546}{480}=$ $1\frac{11}{80}$ the anſwer.

2. Multiply $\frac{4}{17}$ by $\frac{5}{27}$. *Anſ.* $\frac{20}{459}$.

3. Multiply $5\frac{1}{4}$ by $\frac{1}{6}$. *Anſ.* $\frac{7}{8}$.

4. Multiply $\frac{1}{3}$ of 5 by $\frac{3}{4}$ of $\frac{2}{7}$. *Anſ.* $\frac{5}{14}$.

DIVISION OF VULGAR FRACTIONS.

RULE.*

Prepare the fractions as before: Then, invert the diviſor and proceed exactly as in Multiplication: The products will be the quotient required.

EXAMPLES.

1. Divide $\frac{1}{3}$ of 17 by $\frac{2}{3}$ of $\frac{6}{8}$.

$\frac{1}{3}$ of $17=\frac{1}{3}$ of $\frac{17}{1},=\frac{1\times17}{3\times1}=\frac{17}{3}$, & $\frac{2}{3}$ of $\frac{6}{8}=\frac{12}{24}=\frac{1}{2}$;

therefore, $\frac{17}{3}\div\frac{1}{2}=\frac{17\times2}{3\times1}=\frac{34}{3}=11\frac{1}{3}$, the quotient required.

2. Divide $\frac{5}{7}$ by $\frac{3}{5}$. *Anſ.* $1\frac{4}{21}$.
3. Divide $12\frac{1}{5}$ by $\frac{1}{3}$ of 7. *Anſ.* $5\frac{8}{35}$.
4. Divide $5\frac{1}{8}$ by $7\frac{3}{4}$. *Anſ.* $\frac{41}{62}$.
5. Divide $\frac{3}{7}$ by 9. *Anſ.* $\frac{1}{21}$.
6. Divide $\frac{1}{2}$ of $\frac{1}{4}$ of $\frac{2}{3}$ by $\frac{1}{8}$ of $\frac{3}{4}$. *Anſ.* $\frac{8}{9}$.

DECIMAL FRACTIONS.

Decimal Fractions are of ſuch a nature, that they vary in the ſame proportion, and are managed by the ſame method of operation, as whole numbers are.

On this account, every proper Fraction is ſuppoſed to be reducible to another, whoſe denominator ſhall be 10, 100, 1000, &c. viz. Unity, with a number of cyphers annexed; and Fractions with ſuch denominators, are called *Decimal Fractions*: Such are $\frac{5}{10}$, $\frac{55}{100}$, $\frac{675}{1000}$, &c.

---

[*] To multiply a fraction by an integer, divide the denominator, or multiply the numerator by it; and to divide by an integer, divide the numerator, or multiply the denominator by it.

As the denominator of a decimal fraction is always 10, or 100, or 1000, &c. the denominators need not be expreſſed: For the numerator only may be made to expreſs the true value. For this purpoſe it is only required to write the numerator with a point before it at the left hand, to diſtinguiſh it from a whole number, when it conſiſts of ſo many figures as the denominator hath cyphers annexed to unity, or 1 : So $\frac{5}{10}$ is written ,5 ; $\frac{33}{100}$,33 ; $\frac{735}{1000}$,735, &c.

Note. The point prefixed is called a Separatrix.

But if the numerator has not ſo many places as the denominator has cyphers, put ſo many cyphers before it, viz at the left hand, as will make up the defect ; ſo write $\frac{5}{100}$ thus, ,05 ; and $\frac{6}{1000}$ thus, ,006, &c. And thus do theſe fractions receive the form of whole numbers.

The 1ſt, 2d, 3d, 4th, &c. places of decimals, counting from the left hand toward the right, are called primes, ſeconds, thirds, fourths, &c.

We may conſider unity as a fixed point from whence whole numbers proceed infinitely increaſing toward the left hand, and decimals infinitely decreaſing toward the right hand to 0, as in the following

TABLE.

C Millions	X Millions	Millions	C Thouſands	X Thouſands	Thouſands	Hundreds	Tens	Units		Tenth Parts	Hundredth Parts	Thouſandth Parts	X Thouſandth Parts	C Thouſandth Parts	Millionth Parts	X Millionth Parts	C Millionth Parts
9	8	7	6	5	4	3	2	1	,	2	3	4	5	6	7	8	9

From this table it is evident, that, in decimals, as well as in whole numbers, each figure takes its value by its diſtance from unit's place: If it be in the firſt place after units (or the ſeparating point) it ſignifies tenths; if in the ſecond, hundredths, &c. decreaſing in each place in a tenfold proportion.

Conſequently, every ſingle figure expreſſing a decimal, has for its denominator a unit or 1, with ſo many cyphers as its place is diſtant from unit's place: Thus ,2 in the decimal part of the table$=\frac{2}{10}$; ,3$=\frac{3}{100}$; ,4$=\frac{4}{1000}$ &c. And if a decimal be expreſſed by ſeveral figures, the denominator is 1, with ſo many cyphers as the loweſt figure is diſtant from unit's place. So ,357 ſignifies $\frac{357}{1000}$, and ,0063$=\frac{63}{10000}$, &c.

Cyphers, placed at the right hand of a decimal fraction, do not alter its value, ſince every ſignificant figure continues to poſſeſs the ſame place: So ,5, ,50, and ,500 are all of the ſame value, and each equal to $\frac{1}{2}$.

But cyphers, placed at the left hand of a decimal, do alter its value, every cypher depreſſing it to $\frac{1}{10}$ of the value it had before, by removing every ſignificant figure one place further from the place of units. So ,6; ,06, ,006, all expreſs different decimals, viz. ,6, $\frac{6}{10}$; ,06, $\frac{6}{100}$; ,006, $\frac{6}{1000}$.

Hence may be obſerved the contrary effect of cyphers being annexed to whole numbers, and decimals.

It is likewiſe evident from the table, that, ſince the places of decimals decreaſe in a tenfold proportion from units downwards, ſo they conſequently increaſe in a tenfold proportion from the right hand toward the left, as the places of whole numbers do: For, ten hundredth parts make one tenth; ten tenths make 1; ten units, ten; ten tens, one hundred, &c. viz. $\frac{10}{100}=\frac{1}{10}$, $\frac{10}{10}=1$, and $1\times10=10$, which proves that decimals are ſubject to the ſame law of Notation, and conſequently of operation, as whole numbers are.

Decimal fractions of unequal denominators are reduced to one common denominator, when there are annexed to the right hand of thoſe, which have fewer places, ſo many cyphers, as make them equal in places with that which has the moſt. So theſe decimals, ,5, ,06, ,455, may be reduced to the decimals, ,500, ,060, and ,455, which have all 1000 for their denominator.

Of decimals, that is the greateſt, whoſe higheſt figure is greateſt, whether they conſiſt of an equal or unequal number of places: Thus, ,5 is greater than ,459, for if it be reduced to the ſame denominator with ,459, it will be ,500.

A mixed number, viz. a whole number, with a decimal annexed, is equal to an improper fraction, whoſe numerator is all the figures of the mixed number, taken as one whole number, and the denominator, that of the decimal part. So 45,309 is equal to $\frac{45309}{1000}$, as is evident from the method given to reduce a mixed number to an improper fraction: Thus, $45 \times 1000 + ,309 = \frac{45309}{1000}$ as above.

ADDITION OF DECIMALS.

RULE.

1. Place the numbers, whether mixed, or pure decimals, under each other, according to the value of their places.

2. Find their ſum as in whole numbers, and point off ſo many places for decimals, as are equal to the greateſt number of decimal places in any of the given numbers.

EXAMPLES.

EXAMPLES.

1. Find the ſum of 19,073+2,3597+223+,0197581 +3478,1+12,358.

19,073

2,3597

223

,0197581

3478,1

12,358

3734,9104581 the ſum.

2. Required the ſum of 429+21,37+355,003+1,07+1,7. *Anſ.* 808,143.

3. Required the ſum of 973+19+1,75+93,7164 +,9501. *Anſ.* 1088,4165.

SUBTRACTION OF DECIMALS.

Rule.—Place the numbers according to their value; then ſubtract as in whole numbers, and point of the decimals as in Addition.

EXAMPLES.

1. Find the difference of 1793,13 and 817,05693.

From 1793,13

Take 817,05693

Remainder 976,07307

2. From 171,195 take 125,9176. *Anſ.* 45,2774.

3. From 219,1384 take 195,91. *Anſ.* 23,2284.

4. From 480 take 245,0075. *Anſ.* 234,9925.

MULTIPLICATION OF DECIMALS.

CASE I.

Rule 1.—Whether they be mixed numbers, or pure decimals, place the factors and multiply them as in whole numbers.

2. Point off ſo many figures from the product as there are decimal places in both the factors; and if there be not ſo many places in the product, ſupply the defect, by prefixing cyphers.

EXAMPLES.

1. Multiply ,02345
by ,00163

$$\begin{array}{r}
7035\\
14070\\
2345\\
\hline
,0000382235
\end{array}$$

the product.

2. Multiply 25,238 by 12,17 *Anſ.* 307,14646.

3. Multiply ,3759 by ,945. *Anſ.* ,3552255.

4. Multiply ,84179 by ,0385. *Anſ.* ,032408915.

To multiply by 10, 100, 1000, &c. remove the ſeparating point ſo many places to the right hand, as the multiplier has cyphers.

$$\text{So }\ ,345\left\{\text{Mult.}\ \text{by}\left\{\begin{array}{l}10\\100\\1000\end{array}\right\}\text{makes}\left\{\begin{array}{l}3,45\\34,5\\345\end{array}\right.\right.$$

For ,345 × 10 is 3,450, &c.

CASE II.

To contract the operation, ſo as to retain ſo many decimal places in the Product as may be thought neceſſary.

Rule 1.—Write the unit's place of the multiplier under that figure of the multiplicand, whoſe place you would reſerve in the product; and diſpoſe of the reſt of the figures in a contrary order to what they are uſually placed in.

2. In multiplying, reject all the figures which are to the right hand of the multiplying digit, and ſet down the products, ſo that their right hand figures may fall in a ſtraight line below each other; obſerving to increaſe the firſt figure of every line with what would ariſe by carrying 1 from 5 to 15, 2 from 15 to 25, 3 from 25 to 35, &c. from the preceding figures, when you begin to multiply, and the ſum will be the product required.

EXAMPLES.

1. It is required to multiply 56,7534916 by 5,376928, and to retain only five places of decimals in the product.

Contracted way.	*Common way.*	
56,7534916	56,7534916	
829673,5	5,376928	
28376746 . .	45	40279328
1702605 . . .	113	5069832
397274	5107	814244
34052	34052	09496
5108	397274	4412
113	1702604	748
45	28376745	80
305,15943	305,15943	80818048

By the operation in the *common way*, it is evident that all the figures, which are cut off at the right hand, by the perpendicular line, are wholly omitted in the *contracted way*, and the laſt product here is the firſt there; conſequently, the reaſon of placing the multiplier in a reverſe order, muſt appear very plainly.

DIVISION OF DECIMALS.

RULE 1.—The places of decimal parts in the diviſor and quotient counted together, muſt always be equal to thoſe in the dividend ; therefore divide as in whole numbers, and, from the right hand of the quotient, point off ſo many places for decimals, as the decimal places in the dividend exceed thoſe in the diviſor.

2. If the places of the quotient be not ſo many as the rule requires, ſupply the defect by prefixing cyphers to the left hand.

3. If at any time there be a remainder, or the decimal places in the diviſor be more than thoſe in the dividend, cyphers may be annexed to the dividend, or to the remainder, and the quotient carried on to any degree of exactneſs.

EXAMPLES.

1.	2.
219),117841075(,000538087, &c.	,3719)38,0000(102,178, &c.
1095	3719
834	8100
657	7438
1771	6620
1752	3719
1907	29010
1752	26033
1555	29770
1533	29752
22	18

In Example 1, the diviſor having no decimals, the quotient muſt have ſo many as there are in the dividend. In Example 2, the dividend being an integer, muſt have at leaſt ſo many cyphers annexed as there are decimals in the diviſor, and ſo far the quotient will be whole numbers ; then annexing more cyphers, the remaining figures in the quotient will be decimals, according to the Rule.

3. 133)5737(43,1353+

4. 23,7)65321(2756,16+

Ex. 5.

5. *72)918,217(12753+
6. 25,17)315,6293(1253+
7. ,317)29,417(92+
8. 37,9),0059374(156+
9. ,375),173948375(463862+

CASE II.

To contract Diviſion, when there are many decimals in the dividend, and the diviſor is large.

RULE 1.—Whatever place of the dividend correſponds with the unit's place of the diviſor, at the firſt ſtep of the diviſion, the ſame place muſt the firſt figure of the quotient have.

2. In dividing, reject the laſt right hand figure of the diviſor, at every ſtep (inſtead of bringing down a figure, as in common) and make the laſt remainder the dividend for the new diviſor at every ſtep: Thus continue the diviſion until the diviſor ſhall be exhauſted.

99,5678)4,6789837568(,0469931 quotient
3982712
99,567)696271
597402
99,56) 98869
89604
99,5) 9265
8955
99) 310
297
9) 13
9
Remainder 4

Here, the unit's place of the diviſor in the firſt ſtep falls under 7, in the place of hundredths in the dividend; therefore I put 4, the firſt quotient figure, in the place of hundredths, by prefixing a cypher.

I have ſet down every diviſor, to explain the work; but you need only put a daſh over every figure rejected, as you proceed, to ſhow it is omitted.

---

* The following queſtions are left unpointed in the quotient, to exercife the learner.

When decimals or whole numbers are to be divided by 10, 100, 1000, &c. (viz. unity with cyphers) it is performed by removing the ſeparatrix, in the dividend, ſo many places toward the left hand, as there are cyphers in the diviſor.

EXAMPLES.

10	Dividing	7654	The quot. is	765,4
100				76,54
1000				7,654
10000				,7654

REDUCTION OF DECIMALS.

CASE I.

To reduce a Vulgar Fraction to its equivalent Decimal.

RULE. Divide the numerator by the denominator, as in diviſion of decimals, and the quotient will be the decimal required :—Or, ſo many cyphers as you annex to the given numerator, ſo many places muſt be pointed off in the quotient, and if there be not ſo many places of figures in the quotient, the deficiency muſt be ſupplied by prefixing ſo many cyphers before the quotient figures.

EXAMPLES.

1. Reduce $\frac{1}{8}$ to a decimal. 8)1,000

,125 *Anſ.*

2. Reduce $\frac{3}{8}$, $\frac{5}{8}$, and $\frac{2}{3}$ to decimals.
Anſwers. ,375. ,625. ,666+.

3. Reduce $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, $\frac{1}{3}$, $\frac{4}{5}$, $\frac{5}{6}$, and $\frac{7}{8}$ to decimals.
Anſwers. ,25. ,5. ,75. ,333+. ,8. ,833+. ,875.

4. Reduce $\frac{5}{19}$, $\frac{27}{39}$, $\frac{12}{480}$, and $\frac{9}{36}$ to decimals.
Anſwers. ,263+. ,692+. ,025. ,25.

CASE II.

To reduce numbers of different denominations, as of Money, Weight and Meaſure, to their equivalent decimal values.

Rule 1.—Write the given numbers perpendicularly under each other, for dividends; proceeding orderly from the leaſt to the greateſt.

2. Oppoſite to each dividend, on the left hand, place ſuch a number, for a diviſor, as will bring it to the next ſuperiour denomination, and draw a line perpendicularly between them.

3. Begin with the higheſt, and write the quotient of each diviſion as decimal parts on the right hand of the dividend next below it, and ſo on, until they are all uſed, and the laſt quotient will be the decimal ſought.

Examples.

1. Reduce 17s. 8$\frac{3}{4}$d. to the decimal of a pound.

```
 4 | 3,
12 | 8,75
   | ---------
20 | 17,729166, &c.
     ---------
     ,886458, &c. the decimal required.
```

Here, in dividing 3 by 4, I ſuppoſe two cyphers to be annexed to the 3, which make it 3,00, and ,75 is the quotient, which I write againſt 8 in the next line; this quotient, viz. 8,75, being pence and decimal parts of a penny, I divide them by 12, which brings them to ſhillings and decimal parts; I therefore divide by 20, and (there being no whole number) the quotient is decimal parts of a pound.

2. Reduce 1, 2, 3, 4, and ſo on to 19 ſhillings, to decimals.

Shillings.	1	2	3	4	5	6
Anſwers.	,05.	,1.	,15.	,2.	,25.	,3.
Shillings.	7	8	9	10	11	12
Anſwers.	,35.	,4.	,45.	,5.	,55.	,6.

Shillings.

Shillings.	13	14	15	16	17	18	19
Anſwers.	,65.	,7.	,75.	,8.	,85.	,9.	,95.

Here, when the ſhillings are even, half the number, with a point prefixed, is their decimal expreſſion; but if the number be odd, annex a cypher to the ſhillings, and then halving them, you will have their decimal expreſſion.

*Reduce 1, 2, 3, and ſo on to 11 pence, to the decimals of a ſhilling.

Pence.	1	2	3	4	5	6
Anſwers.	,083+.	,166.	,25.	,333+.	,416+.	,5.
Pence.	7	8	9	10	11	
Anſwers.	,583+.	,666+.	,75.	,833+.	,916+.	

4. Reduce 1, 2, 3, &c. to 11 pence, to the decimals of a pound.

Pence.	1	2	3	4
Anſwers.	,00416+.	,0083+.	,0125.	,01666+.
Pence.	5	6	7	8
Anſwers.	,0208+.	,025.	,02916+.	,0333+.
Pence.	9	10	11	
Anſwers.	,0375.	,0416+.	,04583+.	

5. Reduce 1, 2 & 3 farthings to the decimals of a penny.
1qr.=,25d. 2qr.=,5d. and 3qr.=,75d. *Anſwers.*

6. Reduce 1, 2 and 3 farthings to the decimals of a ſhilling.
Anſwers. 1qr.=,02083s+. 2qrs.=,04166s+. 3qrs.=,0625s.

7. Reduce 1, 2 and 3 farthings to the decimals of a pound.
Anſ. 1qr.=£,0010416+ 2qrs.=£,002083+ 3qrs. =£,003125.

8. Reduce 13s. 5½d. to the decimal of a pound.
Anſ. ,6729+.

9. Reduce 7 Cwt. 3qr. 17℔ 10oz. 12dr to the decimal of a ton. *Anſ.* 39538+.

---

* The anſwers to this queſtion are the ſame as the decimal parts of a foot.

10. Reduce 10oz. 13pwt. 9gr. to the decimal of a pound Troy. *Anſ.* ,8890625.

11. Reduce 3qrs. 3n. to the decimal of a yard. *Anſ.* ,9375.

CASE III.

To find the decimal of any number of ſhillings, pence and farthings, by Inſpection.

RULE 1.—Write *half* the greateſt even number of ſhillings for the firſt decimal figure.

2. Let the farthings in the given pence and farthings poſſeſs the ſecond and third places; obſerving, to increaſe the *ſecond* place, or place of *hundredths*, by 5, if the ſhillings be odd, and the third place by 1, when the farthings exceed 12, and by 2 when they exceed 36.

3. If more than three places be needful, divide half the number of farthings in the given pence and farthings (rejecting 24qrs. firſt, if there be ſo many) by 12, and the quotient, written after the three places before found, will give the decimal required.

EXAMPLES.

1. Find the decimal of 13s. 9¾d. by inſpection.

,6 . . = ½ of 12s.
5 for the odd ſhilling.
39 = the farthings in 9¾d.
Add 2 for the exceſs of 36.
——
,691 = decimal required.

2. Find, by inſpection, the decimal expreſſions of 18s. 3¼d. and 17s. 8½d. *Anſ.* £,914 and £,885.

3. Value the following ſums, by inſpection, and find their total, viz. 15s. 3d. + 8s. 11½d. + 10s. 6¼d. + 1s. 8½d. + ½d. + 2¾d. *Anſ.* £1,834 the total.

CASE IV.

To find the value of any given decimal in the terms of the Integer.

Rule 1.—Multiply the decimal by the number of parts in the next leſs denomination, and cut off ſo many places for a remainder, to the right hand, as there are places in the given decimal.

2. Multiply the remainder by the next inferiour denomination, and cut off a remainder as before.

3. Proceed in this manner through all the parts of the integer, and the ſeveral denominations, ſtanding on the left hand, make the anſwer.

EXAMPLES.

1. Find the value of ,73968 of a pound.

```
           20
     --------
     14,79360
           12
     --------
      9,52320
            4
     --------
      2,09280   Anſ. 14s. 9½d.
```

2. What is the value of ,679 of a ſhilling?
Anſ. 8,148d.

3. What is the value of £,9999?
Anſ. 19s. 11¾d.$\frac{9}{10}$—or £1.

4. What is the value of ,617 of a Cwt.?
Anſ. 2qrs. 13lb. 1oz, 10$\frac{6}{10}$dr.

5. What is the value of ,8593 of a lb. Troy?
Anſ. 10oz. 6pwt. 5gr.

6. What is the value of ,397 of a yard?
Anſ. 1qr. 2n.

7. What is the value of ,8469 of a degree?

Anſ. 58m. 6fur. 35po. 0ft. 11in.

8. What is the value of ,569 of a year?

Anſ. 207d. 16h. 26m. 24ſec.

CASE V.

To find the value of any decimal of a pound by Inſpection.

RULE.—Double the firſt figure, or place of tenths, for ſhillings, and if the ſecond figure be 5, or more than 5, reckon another ſhilling; then, after the 5 is deducted, call the figures in the ſecond and third places ſo many farthings, abating 1 when they are above 12, and 2 when above 36, and the reſult will be the anſwer.

Note. When the decimal has but 2 figures, if any thing remain after the ſhillings are taken out, a cypher muſt be annexed to the right hand, or ſuppoſed to be ſo.

EXAMPLES.

1. Find the value of £,876 by inſpection.

16s. =double of 8.
1s. for the 5 in the ſecond place, which is to (be taken out of 7,
and 6½d.=26 farthings, remain to be added;
deduct ¼d. for the exceſs of 12.

17s. 6¼d. the *Anſ.*

2. Find, by inſpection, the value of £,49.

8s. - - = double of 4.
1s. - - for the 5 in the place of hundredths.
10d. = 40 farthings, a 0 being annexed to the (remaining 4.
Ded. ½d. for the exceſs of 36.

9s. 9½d. the anſwer.

3. Find the value of £,097 by inſpection.
Anſ 1s. 11¼d.

4. Value the following decimals, by inſpection, and find their ſum, viz. £,185+£,537+£,916+£,24+£,5+£,25+£,09+£,008. *Anſ.* £3 16s. 6d.

FEDERAL MONEY.

The pupil being well acquainted with decimals, it will be proper to introduce here an account of the Federal Money.

As the Money of account proceeds in a decuple, or tenfold proportion, ſo, any number of Dollars, Dimes, Cents and Mills, is, ſimply, the expreſſion of Dollars and Decimal parts of a Dollar:—Thus, 9 Dollars and 8 Dimes are expreſſed $9,8=9\frac{8}{10}$ doll.—12 Dollars, 4 Dimes, and 7 Cents, thus, $12,47=12\frac{47}{100}$ doll.—20 Dollars, 3 Dimes, 4 Cents and 5 Mills, thus, $20,345=20\frac{345}{1000}$ doll. 100 Dollars and 9 Mills, thus, $100,009=100\frac{9}{1000}$ doll. and 50 Dollars, 5 Cents, thus, $50,05=50\frac{5}{100}$ doll. Wherefore it is, in all reſpects, added, ſubtracted, multiplied and divided, the ſame as decimals; and, of all Coins, it is the moſt ſimple.

Note.			*marked*
10 Mills	*make one*	Cent.	m. c.
10 Cents		Dime.	d.
10 Dimes		Dollar.	D.
10 Dollars		Eagle.	E.

ADDITION OF FEDERAL MONEY.

Add 25½ Eagles; 7 Dollars, 8 Dimes, 3 Cents, 4 Mills; 125 Dollars, 8 Cents; 5 Eagles, 9 Mills; 18 Dollars, 7 Cents and 4 Mills, together.* 1ſt.

---

* It may be obſerved that the ſum exhibits the particular number of each different piece of money contained in it, viz. 455997 mills$=45599\frac{7}{10}$ cents$=4559\frac{97}{100}$ dimes$=455\frac{997}{1000}$ dollars$=45\frac{5997}{10000}$ eagles$=$
E. D. d. c. m.
45 5, 9 9 7.

Alſo,

	Eagles.	Dollars.	Dimes.	Cents.	Mills.
1ſt.	25	5			
2d.		7,	8	3	4
3d.	12	5,	0	8	0
4th.	5	0,	0	0	9
5th.	1	8,	0	7	4
Sum	45	5,	9	9	7

Note. That Dollars occupy the firſt place at the left hand of the comma, and Eagles, all the places at the left of Dollars: But Eagles and Dollars, reckoned together, expreſs the number of Dollars contained in the ſum, as 349 is 34 Eagles and 9 Dollars; equal to 349 Dollars, &c.

SUBTRACTION.

	E. D. d. c. m.	D. d. c. m.	D. d. c. m.
From	13479,8 1 5	495641,0 0 1	798,
Take	8985,9 4 6	218796,7 9 5	459,3 7 9
Rem.	4493,8 6 9	276844,2 0 6	338,6 2 1
Proof.	13479,8 1 5		

MULTIPLICATION.

When you have pointed off the decimals in the product, according to the rule in Multiplication of Decimals, all beyond the Mills, or third place of decimals, are decimal parts of a Mill.

D. d. c. m.

Bought 37 horſes for ſhipping, at 48, 5 7 3 per head: What came they to?

D. d. c. m.

Alſo, the names of the Coins, leſs than a dollar, are ſignificant of their values.

For the *Mill*, which ſtands in the 3d place, at the right hand of the comma, or place of thouſands, is contracted from *Mille*, the Latin for *Thouſand*:—*Cent*, which occupies the ſecond place, or place of Hundredths, is an abbreviation of *Centum*, the Latin for *Hundred*:—And *Dime*, which is in the firſt place, or place of tenths, is derived from *Diſme* the French for *Tenths*.

D. d. c. m.
48,5 7 3
3 7
340011
145719
Anſ. 1797,201
D. d. c. m.

D. d. c. m.
Mult. 45,8 4 6
by 23,0 9 4
183384
412614
1375380
91692
Anſ. 1058,767$\frac{524}{1000}$.
D. d. c. m.

DIVISION.

1. If 1000 oranges coſt 10 dollars, what is that a piece?

D.d.c. D.d.c.
1000)10,0 0(0,0 1 *Anſ.**
1000
D. d. c.

2. If 3730 buſhels of corn coſt 2025,3 9 what is that per buſhel?

D. d. c. D. d. c.
3730)2025,39(0,5 4 3 *Anſ.*
1865 0
16039
14920
11190
11190

3. Divide 12976 dollars between 7 men.

7)12976
1853,714$\frac{2}{7}$ *Anſ.* in dol. dim. &c.
D.d.c.m.

---

* And here I would remind the learner, that, when he has brought down all his whole numbers, or dollars, in the dividend, he muſt place a comma in the quotient; and if, when he has brought down the next figure, he cannot have the diviſor once, he muſt place a cypher at the right hand of the comma, in the place of dimes.

DECIMAL TABLES of Coin, Weight, and Meaſure.

TABLE I. COIN.

£1 the Integer.

Shil.	dec.	Shil.	dec.
19	,95	9	,45
18	,9	8	,4
17	,85	7	,35
16	,8	6	,3
15	,75	5	,25
14	,7	4	,2
13	,65	3	,15
12	,6	2	,1
11	,55	1	,05
10	,5		

Pence.	Decimals.
11	,045833
10	,041666
9	,0375
8	,033333
7	,029166
6	,025
5	,020833
4	,016666
3	,0125
2	,008333
1	.004166

Farth.	Decimals
3	,003125
2	,0020833
1	,0010416

TABLE II.

COIN & LONG MEAS.
1 Shilling & 1 Foot the Integer.

Pence & Inches.	Decimals.
11	,916666
10	,833333
9	,75
8	,666666
7	,583333
6	,3
5	,416666
4	,333333
3	,25
2	,166666
1	.083333

Farthings.	Decimals
3	,0625
2	,041666
1	,020833

TABLE III.

TROY WEIGHT.
1 Pound the Integer.
Ounces the ſame as Tab. II.

Penny-weights.	Decimals.
10	,041666
9	,0375
8	,033333
7	,029166
6	,025
5	,020833
4	,016666
3	,0125
2	,008333
1	.004166

Grains.	Decimals.
12	,002083
11	,00191
10	,001736
9	,001562
8	,001389
7	,001215
6	,001042
5	,000868
4	,000694
3	,000521
2	,000347
1	,000173

1 Oz. the Integer.
Pennyweights the ſame as Shillings in Tab. I.

Grains.	Decimals
12	,025
11	,022916
10	,020833
9	,01875
8	,016666
7	,014583
6	,0125
5	,010416
4	,008333
3	,00625
2	,004166
1	,002083

TABLE IV.

AVOIRDUPOIS WT.
112lb. the Integer.

Qrs.	Decimals.
3	,75
2	,5
1	,25

Pounds	Decimals.
27	,241071
26	,232143
25	,223214
24	,214286
23	,205357
22	,196428
21	,1875
20	,178571
19	,169643
18	,160714
17	,151786
16	,142857
15	,133928
14	,125
13	,110761
12	,107143
11	,098214
10	,089286
9	,080357
8	,071428
7	,0625
6	,053571
5	,044643
4	,035714
3	,026786
2	,017857
1	,008928

Ounces	Decimals.
15	,008370
14	,007812
13	,007254
12	,006696

Carried over.

Brought over.

Ounces.	Decimals.
11	,006138
10	,00558
9	,005022
8	,004464
7	,003906
6	,003348
5	,00279
4	,002232
3	,001674
2	,001116
1	,000558

qrs. of ozs.	Decimals.
3	,000418
2	,000279
1	,000139

TABLE V.

AVOIRDUPOIS WT.
1lb. the Integer.

Ounces.	Decimals.
15	,9375
14	,875
13	,8125
12	,75
11	,6875
10	,615
9	,5625
8	,5
7	,4375
6	,375
5	,3125
4	,25
3	,1875
2	,125
1	,0625

Drams.	Decimals.
15	,059493
14	,055587
13	,051681
12	,047775
11	,043868
10	,039962
9	,036056
8	,03215
7	,027343
6	,023437
5	,019531
4	,015625
3	,011718
2	,007812
1	.003906

TABLE VI.

CLOTH MEASURE.
1 Yard the Integer.

Quarters.	Decimals.
3	,75
2	,5
1	,25

Nails.	Decimals.
3	,1875
2	,125
1	,0625

TABLE VII.

LONG MEASURE.
1 Mile the Integer.

Yards.	Decimals.
1000	,568182
900	,511364
800	,454545
700	,397727
600	,34
500	,284091
400	,227272
300	,170454
200	,113636
100	,056818
90	,051136
80	,045454
70	,039773
60	,034091
50	,028409
40	,022727
30	,017045
20	,011364
10	,005682
9	,005114
8	.004545
7	,003977
6	,003409
5	,002841
4	.002273
3	,001704
2	,001136
1	,000568

Feet.	Decimals.
2	0003787
1	,0001892

Inches.	Decimals.
6	,0000947
5	,000079
4	,0000632
3	,0000474
2	,0000316
1	.0000158

TABLE VIII.

LIQUID MEASURE.
1 Gall the Integer.
Quarts the ſame as qrs. in Tab. VI.

1 Pint	,125
3 Gill	,09375
2	,0625
1	,03125

TABLE IX.

TIME.
1 Year the Integer.
Months the ſame as Pence in Tab. II

Days.	Decimals.
365	1,000000
300	,821928
200	,547945
100	,273973
90	,246575
80	,219178
70	,191781
60	,164383
50	,136985
40	,109589

Carried over.

Brought over.		Hours.	Decimals.	Hours.	Decimals.
Days.	Decimals.	21	,875	3	,125
30	,082192	20	,833333	2	,083333
20	,054794	19	,791666	1	,041666
10	,027397	18	,75	Minutes.	Decimals.
9	,024657	17	,708333		
8	,021918	16	,666666	30	,020833
7	,019178	15	,625	20	,013888
6	,016438	14	,583333	10	,006944
5	,013698	13	,541666	9	,00625
4	,010959	12	,5	8	,005555
3	,008419	11	,458333	7	,004861
2	,005479	10	,416666	6	,004166
1	,002739	9	,375	5	,003472
		8	,333333	4	,002777
1 Day the Integer.		7	,291666	3	,002083
Hours.	Decimals.	6	,25	2	,001388
23	,958333	5	,208333	1	,000694
22	,916666	4	,166666		

COMPOUND MULTIPLICATION

Is extremely uſeful in finding the value of goods, &c. And, as in Compound Addition, we carry from the loweſt denomination to the next higher, ſo, we begin and carry in Compound Multiplication; one general rule being, to multiply the price by the quantity.

CASE I.

When the quantity does not exceed 12 *yards, pounds, &c.* ſet down the price of 1, and place the quantity underneath the leaſt denomination, for the multiplier, and, in multiplying by it, obſerve the ſame rules for carrying from one denomination to another, as in Compound Addition.

INTRODUCTORY

INTRODUCTORY EXAMPLES.

	1.	2.	3.
	£. s. d.	£. s. d.	£. s. d.
Multiply	15 17 1	25 12 8	45 9 10
by	2	3	4
	4.	5.	6.
	67 18 6½	19 6 8¼	13 12 11
	5	6	7
	7.	8.	
	31 16 8½	12 17 10½	
	8	9	

PRACTICAL QUESTIONS.

What will 9 yards of cloth, at 5s. 4d. per yard, come to?

	£	s.	d.	
	0	5	4	price of one yard.
Multiply by			9	yards.
Anſ.	£2	8	0	price of 9 yards.

Queſtions.	s.	d.	
2d. 3 yards, at	15	4	per yard.
3d. 6 —— at	9	10	per yard.
4th. 9 —— at	13	7½	per yard.

CASE II.

When the multiplier, that is, the quantity, is above 12, you muſt multiply by two ſuch numbers, as, when multiplied together, will produce the given quantity.

EXAMPLES.

1. What will 144 yards of cloth coſt, at 3s. 5½d. per yard?

	£.	s.	d.	
	0	3	5½	price of one yard.
Multiplied by			12	
Produces	2	1	6	price of 12 yards.
Multiplied by			12	
Anſ.	£24	18	0	price of 144 yards.

Queſtions.		s.	d.		*Anſwers.* £.	s.	d.
2d.	24 yards at	6	3¾	per yard. =	7	11	6
3d.	27 —— at	9	10	—— =	13	5	6
4th.	44 —— at	12	4½	—— =	27	4	6

C A S E III.

When the quantity is ſuch a number, as that no two numbers in the table will produce it exactly ; Then multiply by two ſuch numbers as come the neareſt to it ; and for the number wanting, multiply the given price of one yard by the ſaid number of yards wanting, and add the products together for the anſwer ; but if the product of the two numbers exceed the given quantity, then find the value of the overplus, which ſubtract from the laſt product, and the remainder will be the anſwer.

EXAMPLES.

1. What will 47 yards of cloth, at 17s. 9d. per yard, come to ?

	£.	s.	d.	
	0	17	9	price of one yard.
Multiplied by			5	
Produces	4	8	9	price of 5 yards.
Multiplied by			9	
Produces	39	18	9	price of 45 yards.
Add	1	15	6	price of 2 yards.
Anſ.	41	14	3	price of 47 yards.

Note.—This may be performed by firſt finding the value of 48 yards, from which, if you ſubtract the price of 1, the remainder will be the anſwer, as above.

Queſtions.							*Anſwers.*		
	Yds.		s.	d.			£	s.	d.
2d.	75	at	5	7½	per yard,	=	21	1	10½
3d.	67½	—	16	3¼	———	=	54	18	3¼
4th.	59	—	9	7	———	=	28	5	5

C A S E IV.

When the quantity is any number above the Multiplication Table: Multiply the price of 1 yard by 10, which will produce the price of 10 yards: *This* product multiplied by 10, will give the price of 100 yards; then, if the quantity do not exceed hundreds, you muſt multiply the price of one hundred by the number of hundreds in your queſtion; the price of ten by the number of tens; and the price of unity, or 1, by the number of units: Laſtly, add theſe ſeveral products together, and the ſum will be the anſwer.

EXAMPLES.

1. What will 359 yards of cloth, at 4s. 7½d. per yard, amount to?

	£.	s.	d.	
	0	4	7½	price of one yard.
			10	
	2	6	3	price of 10 yards.
			10	
	23	2	6	price of 100 yards.
			3	
	69	7	6	price of 300 yards.
5 times the price of 10 yards=	11	11	3	price of 50 yards.
9 times the price of 1 yard=	2	1	7½	price of 9 yards.
Anſ.	£83	0	4½	price of 359 yards.

	Queſtions.	s.	d.		£.	s.	d.
2d.	297 yards, at	17	3½	per yard, =	256	15	7½
3d.	473 ———	9	11¼	——— =	235	0	5¼
4th.	512 ———	15	10	——— =	405	6	8

C A S E V.

When the quantity does not exceed 200, nor the price 12 pence, then, by the pence table, find what it comes to, at one penny per yard, &c. and multiplying this ſum by the number of pence in the price, the product will be the anſwer.

EXAMPLES.

1. What will 129 yards coſt, at 9¾d. per yard.

	£.	s.	d.	
129 pence =	0	10	9	the price at 1d. per yard?
			9	
	4	16	9	the price at 9d. per yard.
Half of 10s. 9d. =		5	4½	the price at ½d. per yard.
1 fourth of 10s. 9d. =		2	8¼	the price at ¼d. per yard.
Anſ. £5		4	9¾	the price at 9¾d. per yard.

	Queſtions.				*Anſwers.*		
	Yds.				£.	s.	d.
2d.	148½	at	11¼d.	per yard, =	6	19	2½
3d.	75	—	7	——— =	2	3	9
4th.	63½	—	3¾	——— =	0	19	10

C A S E VI.

To find the value of one hundred weight :—As 112 is the groſs hundred, ſo 112 farthings are = 2s. 4d. and 112 pence = 9s. 4d.; therefore if the price be farthings, or not more than 3d. multiply 2s. 4d. by the farthings in the price of 1lb.; or, if the price be pence, multiply 9s. 4d. by the pence in the price of 1lb. and in either caſe the product will be the anſwer.

EXAMPLES.

1. What will 1 Cwt. of chalk come to, at 1½d. per lb. ?

	£.	s.	d.	
112 farthings =	0	2	4	price 1 Cwt. at ¼d. per lb.
1½d. =			6	farthings in the price.
Anſ. £	0	14	0	price of 1 Cwt. at 1½d. per lb.

2. 1 Cwt. of tin at 2¼d. per lb.

	£	s.	d.
Price of 1 Cwt. at ¼d. per lb.		2	4
Farthings in the price of 1 lb.			9
Price of 1 Cwt. at 2¼d. per lb.	*Anſ.* £1	1	0

3. 1 Cwt. of lead at 7d. per lb.

	£	s.	d.
Price of 1 Cwt. at 1d. per lb.		9	4
Pence in the price of 1 lb.			7
Price of 1 Cwt. at 7d. per lb.	£3	5	4

Queſtions. Cwt.			*Anſwers.* £.	s.	d.
4th. 1	of Copper at ¾d. per lb.	=	0	7	0
5th. 1	ditto ——— 2½d. ½q.	=	1	4	6
6th. 1	ditto ——— 4½d.	=	2	2	0

CASE. VII.

To find the value of two or more hundreds, by having the price of one pound:—Firſt, find the price of 1 Cwt. by the laſt Caſe, and then proceed to find the value of the whole, by Caſe 1ſt, or 2d, as the queſtion may require.

EXAMPLES.

1. What is the value of 5¼cwt. of ſugar, at 6d. per lb ?

£. s. d.

£. s. d.
0 9 4 price of 1 Cwt. at 1d. per lb.
6

1 16 0 price of ditto at 6d. per lb.
5

14 0 0 price of 5 Cwt.
qr. of Cwt. = 0 14 0 price of ¼ Cwt.

Anſwer, £ 14 14 0 price of 5¼ Cwt.

Queſtions.	Cwt.			*Anſwers.* £.	s.	d.
2d.	4	of ſugar at 2½d. per lb.	=	4	13	4
3d.	8½	——— 5d. ———	=	19	16	8
4th.	7	——— 4¾d. ———	=	15	10	4

C A S E VIII.

To find the value of a hundred weight when the price of 1 lb. *is any number of pounds and ſhillings; or ſhillings, pence and farthings*:—Multiply the price of 1 lb. by 7, its product by 8, and *this* product by 2; which laſt product will be the anſwer required.

E X A M P L E S.

What will 1 Cwt. of Tobacco coſt, at 5s. 7½d. per lb.?

£. s. d.
0 5 7½ price of 1 lb.
7

1 19 4½ price of 7 lb.
8

15 15 0 price of 56 lb. or ½ Cwt.
2

Anſ. £ 31 10 0 price of 112 lb. or 1 Cwt.

Queſtions

Queſtions.		s.	d.		*Anſwers.* £.	s.	d.
2d.	1 Cwt. at	3	10½ per lb.	=	21	14	0
3d.	1 ditto —	9	6 ——	=	53	4	0
4th.	1 ditto —	16	11½ ——	=	94	19	4

COMPOUND DIVISION

Is the dividing of numbers of different denominations: In doing which, always begin at the higheſt, and when you have divided that, if any thing remains, reduce it to the next lower denomination, and ſo on, till you have divided the whole; taking care to ſet down your quotient figures under their reſpective denominations.

INTRODUCTORY EXAMPLES.

1.
£. s. d.
Divide 549 17 9 by 5
Quotient £109 19 6½

2.
£. s. d.
4)731 5 10¼

3.
£. s. d.
2)97 19 10½

4.
£. s. d.
6)37 11 4¾

5
£. s. d.
7)193 15 9½

6.
T. Cwt. qr. lb. oz. dr.
3)29 13 2 25 12 13

7.
lb. oz. pwt. gr.
12)529 10 7 14

8.
Deg. m. f. p. ft. in. bc.
6)97 55 7 35 4 2 1

9.
lb. ℥ ʒ ℈ gr.
2)37 10 5 1 12

10. Suppoſe that two places lie eaſt and weſt of each other, and it is found by obſervation, that it is noon at the former, 2 hours 6′ 30″ ſooner than at the latter; how many degrees are they aſunder?

4′) 2h. 6′ 30″

31° 37′ 30″ *Anſ.*

Reduce the hours and minutes to minutes, then, minutes divided by 4′, give degrees in the quotient.

11. The longitude of Cambridge is 4h. 44′ 17″, and that of Philadelphia, 5h. 0′ 43″; how many degrees difference?

5h. 0′ 43″
4 44 17

4′)0 16 26

4° 6′ 30″ *Anſ.*

PRACTICAL QUESTIONS.

CASE I.

Having the price of any number of yards, &c. within the pence table, to find the price of unity, or 1 *yard:*—If the quantity do not exceed 12, proceed by ſetting down the price and dividing it by the quantity; which quotient will be the price of 1 yard, required; but if the quantity exceed 12, then divide by 2 ſuch numbers, as, when multiplied together, will produce the quantity, and the laſt quotient will be the value of 1 yard, required.

Note. This caſe proves the firſt and ſecond caſes in Compound Multiplication.

1. If 9 yards of cloth coſt £4 3s. 7½d. what is it per yard?

£ s. d.
9)4 3 7½

0 9 3½ *Anſ.*

2. If 7 ells coſt £5 17s. 5d. what coſt 1 ell ?

3. If 11 ſheep coſt £6 5s. 9d. what did each coſt ?

4. If 12 gallons of rum coſt £8 11s. $9\frac{1}{2}$d. what is it per gallon ?

Note. When the given quantity (or diviſor) is large, and not a compoſite number, the operation may be performed by long Diviſion.

CASE II.

Having the price of a hundred weight, to find the price of 1lb.——Divide the given price by 8, that quotient by 7, and this quotient by 2, and the laſt quotient will be the price of 1lb. required.

1. If 1cwt. of flax coſt £2 7s. 8d. what is that per lb. ?

£ s. d.
8)2 7 8
7)0 5 $11\frac{1}{2}$
2)0 0 10 $\frac{6}{7}$qr.
0 0 $5\frac{3}{28}$d. price of one pound.

2. At £3 10s. per Cwt. what coſt 1lb. ?
Anſ. $7\frac{1}{2}$d.

3. At £6 6s. per Cwt. what coſt 1lb. ?
Anſ. 1s. $1\frac{1}{2}$d.

4. At £42 11s. 8d. per Cwt. what coſt 1lb. ?
Anſ. 7s. $7\frac{1}{4}$d.

CASE III.

Having the price of ſeveral hundred weight, to find the price per lb.——Divide the whole price by the number of hundreds, which will give the price per Cwt. and then proceed as in the laſt Caſe.

1. If 5Cwt. of ſugar coſt £13 8s. 4d. what is that per lb. ?

£ s. d.

£ s. d.
5) 13 8 4

8) 2 13 8 price of 1Cwt.

7) 0 6 $8\frac{1}{2}$ price of 14lb. or $\frac{1}{8}$ Cwt.

2) 0 0 $11\frac{1}{2}$ price of 2lb. or $\frac{1}{56}$Cwt.

0 0 $5\frac{3}{4}$ price of 1lb.

2. If 8Cwt. of cocoa coſt £15 17s. 4d. what is that per lb.? *Anſ.* $4\frac{1}{4}$d.

3. If $3\frac{1}{4}$Cwt. of ſugar coſt £9 17s. 2d. what is that per lb.? *Anſ.* $6\frac{1}{2}$d.

4. If $1\frac{3}{4}$Cwt of cotton wool coſt £6 10s. 8d. what is that per lb.? *Anſ.* 8d.

Note. This Caſe proves the 7th in Compound Multiplication.

C A S E IV.

Having the price of any number of yards, &c. to find the price of 1 *yard:*——Divide the price by the quantity, beginning at the higheſt denomination, and, if any thing remain, reduce it into the next, and every inferiour denomination, and, at each reduction, divide as before, remembering, each time, to add the odd ſhillings, pence, &c. if there be any, and you will have the value of unity required.

Note. If there be $\frac{1}{4}$, $\frac{1}{2}$ or $\frac{3}{4}$ of a yard, pound, &c. multiply both the price and quantity by 4, and then proceed as above directed.

1. If $95\frac{1}{2}$lb. of figs coſt £16 13s. $6\frac{3}{4}$d. what are they per lb.?

	lb.		£	s.	d.
Quantity =	$95\frac{1}{2}$	Price =	16	13	$6\frac{3}{4}$
Mult. by	4				4
Produces	382 for a divr.	Pro.	£66	14	3 for a divid.

£ s. d.

```
     £   s.  d.  £  s.  d.
382)66  14   3  (0   3  5¾  250/382 per lb.
    20
   ————
382)1334(3
    1146
   ————
     188
      12
   ————
382)2259(5
    1910
   ————
     349
       4
   ————
382)1396(3
    1146
   ————
     250
```

2. If 147 buſhels of rye coſt £47 12s. 6d. what is it per buſhel? *Anſ.* 6s. 5$\frac{3}{4}$d.

3. If 33$\frac{1}{4}$ yards of baize coſt £25 13s. 9$\frac{1}{2}$d. what is it per yard? *Anſ.* 15s. 5$\frac{1}{4}$d. $\frac{95}{133}$.

Note. This proves the 3d and 4th Caſes in Multiplication.

REDUCTION OF COINS.

RULES for reducing the Federal Coin, and the Currencies of the ſeveral United States; alſo Engliſh, Iriſh, Canada, Nova-Scotia, Livres Tournois, and Spaniſh milled Dollars, each, to the *par* of all the others.

I. *To reduce New Hampſhire, Vermont, Maſſachuſetts, Rhode Iſland, Connecticut, and Virginia currency.*

1. To Federal Money.

Rule.—Reduce the ſhillings, pence and farthings, to decimals, by Inſpection, (Caſe 3d, Dec. Frac.) divide the whole by 3, putting the comma one figure further to the right hand in the quotient than in the pounds of the dividend, and the quotient will be the anſwer in dollars, cents and mills.

1. Reduce £349 19s. 1d. to dollars.

,9 = $\frac{1}{2}$ the ſhillings.
,05 = odd ſhillings.
4 = qrs. in 1d.
——
,954 = decimal.
3)349,954 D. c. m.
1166,513=1166,51 3
Anſwer.

2. Reduce 19s. 1$\frac{3}{4}$d. to dollars.

,9
,05
7
——
,957 = decimal.
3),957 D. c.
3,19 = 3 19

3. Reduce 1s. to cents.
1s. = ,05 then
3),05 c. m.
0,166$\frac{2}{3}$ = 16 6$\frac{2}{3}$

4. Reduce 1d.
1d. = 4qrs.
3),004 c. m.
,001,3$\frac{1}{3}$ = 1 3$\frac{1}{3}$

5. Reduce 1qr.
1qr. = ,001041 and
3),001041
0,00,347=3$\frac{47}{100}$ mills.

2. To New-York and North Carolina currency.

Rule.—Add one third to the given ſum.

Reduce £100 N. Hampſhire, &c. to New-York, &c.

£.
3)100
+ 33 6 8
——
£133 6 8 *Anſ.*

3. To Pennſylvania, New-Jerſey, Delaware, and Maryland currency.

Rule.—Add one fourth to the given ſum.

Reduce £100 New-Hampſhire, &c. to Pennſylvania, &c.

4)100
+ 25
——
£125 *Anſ.*

4. To South Carolina and Georgia currency.

Rule.—Multiply the given ſum by 7, and divide the product by 9.

Reduce £100 New-Hampſhire, &c. to South Carolina, &c.

100
7
——
9)700
——
£77 15 6$\frac{2}{3}$ *Anſ.*

5. To Engliſh Money.

Rule.—Deduct one 4th from the given ſum.

Reduce £100 New-Hampſhire, &c. to Engliſh money.

```
  4)100
  — 25
  ---
  £75 Anſ.
```

6. To Iriſh Money.

Rule.—Multiply the given ſum by 13, and divide the product by 16.

Reduce £100 New-Hampſhire, &c. to Iriſh money.

```
          100
          ------
           4×3+the
          ----  given
          400   ſum.
            3
          ----
         1200
         +100
         ----
16=4×4)1300
         ----
       4)325
         ----
       £ 81 5 Anſ.
```

7. To Canada and Nova-Scotia currency.

Rule.—Multiply the given ſum by 5, and divide the product by 6.

Reduce £100 New-Hampſhire, &c. to Canada, &c.

```
   100
     5
   ---
 6)500
   ---
 £ 83 6 8 Anſ.
```

8. To Livres Tournois.

Rule.—Multiply the given pounds by 17½, and the product will be Livres:—Or, multiply the ſum in ſhillings by 7; divide the product by 8, and the quotient will be livres, ſous, &c.

Reduce £100 New-Hampſhire, &c. to Livres Tournois.

```
      100  Or,  100
      17½        20
     ----      ----
      700      2000
     100          7
       50      ----
     ----  8)14000
Anſ. 1750     -----
  Liv. Anſ. 1750 Liv.
```

1d.=1ſou. 5½den. 1s.=17½ ſous. £1 = 17½ livres.

9. To Spaniſh milled Dollars.

Rule 1.—When the ſum conſiſts of pounds only, annex a cypher to the pounds, and divide the whole by 3; the quotient is dollars.

Reduce £100 New-Hampſhire, &c. to Dollars.

3)1000

Dol. $333\frac{1}{3}$ *Anſ.*

Rule 2.—When the ſum conſiſts of pounds and ſhillings:—Divide the pounds by 3, and the ſhillings by 6, not ſeparating them in the quotient, and the quotient will be dollars.

Reduce £152 15s. 6d. to dollars.

£ by 3 &
s. by 6. } 152 15/6

509 dol. and (1/6 *Anſ.*

Note. This article may be applied to the federal dollar, it being of the ſame value with a Spaniſh dollar.

II. *To reduce Federal money to New-England and Virginia currency.*

Rule.—Multiply the Federal money by 3, and, if it conſiſt of dollars only, cut off 1 figure, if of cents alſo, cut off three, and if of mills, 4 figures at the right hand; then reduce the figures ſo cut off to farthings, each time cutting off as at firſt, and the left hand figures are pounds, ſhillings, &c.

1. Reduce 1166 dolls. 51c. 3m. to New England currency, or lawful money.

D. c. m.
1166,51 3
3

£349,9539
20

s. 19,0780
12

,936=1d. (*nearly.*

2. Reduce 45 dollars.

D.
45
3

£ 13,5
20

s. 10,0

3. Reduce 12D. 7c. to lawful money.

D. c.
12,07
3

£3,621
20

s.12,420
12

d.5,040

III. *To*

III. *To reduce New-Jerſey, Pennſylvania, Delaware, and Maryland currency.*

1. To New-Hampſhire, Maſſachuſetts, Rhode-Iſland, Connecticut, and Virginia currency.

Rule.—Deduct one fifth from the given ſum.

Reduce £100 New-Jerſey, &c. to New-Hampſhire, &c.

5)100
—20
£80 *Anſ.*

2. To New-York and North-Carolina currency.

Rule.--Add one fifteenth to the given ſum.

Reduce £100 New-Jerſey, &c. to New-York, &c.

15=3×5)100
3)20
+6 13 4+*giv.* [*ſum.*
£106 13 4 *Anſ.*

3. To South-Carolina and Georgia currency.

Rule.—Multiply the given ſum by 28, and divide the product by 45.

Reduce £100 New-Jerſey, &c. to South-Carolina, &c.

100
4×7=28
400
7
45=5×9)2800
5)311 2 $2\frac{2}{3}$
Anſ. £62 4 $5\frac{1}{3}$

4. To Engliſh Money.

Rule.—Multiply the given ſum by 3, and divide the product by 5.

Reduce £100 New-Jerſey, &c. to Engliſh money.

100
3
5)300
£60

5. To Iriſh Money.

Rule. Multiply the New-Jerſey, &c. by 13, and divide the product by 20.

Reduce £100 New-Jerſey, &c. to Iriſh.

100

$$\frac{100}{4\times 3+\text{the [giv. ſum.}}$$

400
3

1200
+100

20=4×5)1300

4)260

£65 *Anſwer.*

6. To Canada and Nova-Scotia currency.

Rule.--Deduct one third from the New-Jerſey, &c.

Reduce £100 New-Jerſey, &c. to Canada, &c.

3)100
—33 6 8

£66 13 4 *Anſ.*

7. To Livres Tournois.

Rule.—Multiply the given ſum by 14, and the product will be Livres Tournois—or multiply the ſum in ſhillings by 7; divide the product by 10, and the quotient will be livres, ſous, &c.

Reduce £100 New-Jerſey, &c. to Livres Tournois.

		Or	
	100		100
	14		20
	400		2000
	100		7
	1400	10)	14000
Liv. *Anſ.*			1400 as before.

£1 = 14 liv.
1s. = 14 ſous.
1d. = 1⅙ ſous.

8. To Spaniſh milled Dollars.

Rule.—Multiply the given ſum by 2⅔—or multiply them by 8; divide the product by 3. If there be ſhillings in the given ſum, for every 7s. 6d. add 1 dollar to the quotient.

Reduce £100 10s. New-Jerſey, &c. to Dollars.

100
8

3)800

266⅔
10s.= 1⅓

Anſwer, 268 Dolls.

Or, 100
2

200
$100\times\frac{2}{3}=66\frac{2}{3}$
$10s.=1\frac{1}{3}$

268 as before.

IV. *To reduce New-York and North-Carolina currency.*

1. To New-Hampſhire, Maſſachuſetts, Rhode-Iſland, Connecticut, and Virginia currency.

Rule. Deduct one fourth from the New-York, &c.

Reduce £100 New-York, &c. to New-Hampſhire, &c.

4)100

—25

£75 *Anſwer.*

2. To New-Jerſey, Pennſylvania, Delaware, and Maryland currency.

Rule. Deduct one ſixteenth from the New-York, &c.

Reduce £100 New-York, &c. to New-Jerſey, &c.

$16=4\times4)100$

4)25

—£6 5

£93 15 *Anſ.*

3. To South-Carolina and Georgia currency.

Rule. Multiply the given ſum by 7, and divide the product by 12.

Reduce £100 New-York, &c. to South-Carolina, &c.

100
7

12)700

£58 6 8 *Anſ.*

4. To Engliſh Money.

Rule. Multiply the given ſum by 9; divide the product by 16.

Reduce £100 New-York, &c. to Engliſh money.

100
9

$16=4\times4)900$

4)225

£56 5 *Anſ.*

5. To Iriſh Money.

Rule. Multiply the given ſum by 39; divide the product by 64.

Reduce £100 New-York, &c. to Iriſh money.

100
———
6 × 6 + thrice the given ſum.
600
6
———
3600
+ 300 = 100 × 3
———
64 = 8 × 8)3900
———
8)487 10
———
£60 18 9 *Anſ.*

6. To Canada and Nova-Scotia currency.

Rule. Multiply the given ſum by 5, and divide the product by 8.

Reduce £100 New-York, &c. to Canada, &c.

100
5
———
8)500
———
£62 10 *Anſ.*

7. To Livres Tournois.

Rule. Multiply the given ſum in ſhillings by 21; divide the product by 32, and the quotient will be livres, ſous, &c.

Reduce £100 New-York, &c. to Livres Tournois.

100
20
———
2000
21
———
2000
4000
———
32 = 4 × 8)42000
———
4)5250
———
Anſwer, 1312½ Liv.

Note.
1d. = $1\frac{3}{32}$ Sous.
1s. = $13\frac{1}{8}$ Sous.
£1 = $13\frac{1}{8}$ Liv.

8. To Spaniſh milled Dollars,

Rule. If the New-York ſum be pounds only, annex a cypher to them, then divide by 4, and the quotient is dollars: But if it be pounds and ſhillings, annex half the ſhillings to the pounds and divide as before, and the quotient is dollars.

Reduce £100 New-York, &c. to dollars.

4)1000
———
250 dollars, *Anſ.*

Reduce £100 8s. to Dollars.

4)1004

251 dollars, *Anſ.*

V. *To reduce South-Carolina and Georgia currency.*

1. To New-Hampſhire, Maſſachuſetts, Rhode-Iſland, Connecticut and Virginia currency.

Rule. Multiply the given ſum by 9, and divide the product by 7.

Reduce £100 South-Carolina, &c. to New-Hampſhire, &c.

100
9

7)900

£128 11 5$\frac{1}{7}$ *Anſ.*

2. To New-Jerſey, Pennſylvania, Delaware and Maryland currency.

Rule. Multiply the given ſum by 45, and divide the product by 28.

Reduce £100 South-Carolina, &c. to New-Jerſey, &c.

100

9×5=45

900
5

28=4×7)4500

4)642 17 1$\frac{5}{7}$

Anſ. £160 14 3$\frac{3}{7}$

3. To New-York and North-Carolina currency.

Rule. Multiply the given ſum by 12, and divide the product by 7.

Reduce £100 South-Carolina, &c. to New-York, &c.

100
12

7)1200

£171 8 6$\frac{6}{7}$ *Anſ.*

4. To Engliſh Money.

Rule. From the given ſum deduct one twenty-eighth.

Reduce £100 South-Carolina, &c. to Engliſh Money.

28=

28=4×7)100

4)14 5 $8\frac{4}{7}$

—3 11 $5\frac{1}{7}$ from the giv. ſum.

£96 8 $6\frac{6}{7}$ *Anſ.*

5. To Canada and Nova-Scotia currency.

Rule. Multiply the given ſum by 15, and divide the product by 14.

Reduce £100 South-Carolina, &c. to Canada, &c.

100
5×3
500
3
14=2×7)1500
2)214 5 $8\frac{4}{7}$
£107 2 $10\frac{2}{7}$

6. To Livres Tournois.

Rule. Multiply the given pounds by $22\frac{1}{2}$, and the product will be livres.

Reduce £100 South-Carolina, &c. to livres.

100
$22\frac{1}{2}$
200
200
50
Anſ. 2250 livres.

Note.
1d.= $1\frac{7}{8}$ ſous.
1s.= $1\frac{1}{8}$ livre.
£1=$22\frac{1}{2}$ liv.

7. To Iriſh Money.

Rule. Multiply the given ſum by 117, and divide the product by 112.

Reduce £100 South-Carolina, &c. to Iriſh.

100
12×9+9 times the given ſum.
1200
9
10800
+100×9=900
112=4×4×7)11700
4)1671 8 $6\frac{6}{7}$
4)417 17 $1\frac{5}{7}$
Anſ. £104 9 $3\frac{3}{7}$

8. To Spaniſh milled Dollars.

Rule. Multiply the given pounds by 30, and divide the product by 7, and if there be ſhillings, turn them into dollars, and add them.

Reduce £100 South-Carolina, &c. to dollars.

100
10×3=30
1000
3
7)3000
Dollars $428\frac{4}{7}$ *Anſ.*

Note, $\frac{1}{7}$=8d.

VI. To

VI. *To reduce Engliſh Money.*

1. To New-Hampſhire, Maſſachuſetts, Rhode-Iſland, Connecticut, and Virginia currency.

Rule. To the Engliſh ſum add one third.

Reduce £100 Engliſh, to New-Hampſhire, &c.

3)100
+33 6 8
£133 6 8 *Anſ.*

2. To New-Jerſey, Pennſylvania, Delaware and Maryland currency.

Rule. Multiply the Engliſh money by 5, and divide the product by 3.

Reduce £100 Engliſh to New-Jerſey, &c.

100
5
3)500
£166 13 4 *Anſ.*

3. To New-York and North-Carolina currency.

Rule. Multiply the Engliſh money by 16, and divide the product by 9.

Reduce £100 Engliſh to New-York, &c.

100
4×4
400
4
9)1600
£177 15 $6\frac{2}{3}$ *Anſ.*

4. To South-Carolina and Georgia currency.

Rule. To the Engliſh money add one twenty-ſeventh.

Reduce £100 Engliſh to South-Carolina, &c.

27=3×9)100
3)11 2 $2\frac{2}{3}$
+3 14 $0\frac{8}{9}$
Anſ. £103 14 $0\frac{8}{9}$

5. To Iriſh Money.

Rule. To the Engliſh ſum add one twelfth.

Reduce £100 Engliſh money to Iriſh money.

12)100
+8 6 8
£108 6 8 *Anſ.*

6. To Canada and Nova-Scotia currency.

Rule. To the Engliſh ſum add one ninth.

Reduce £100 Engliſh to Canada, &c.

9)100

+11 2 $2\frac{2}{3}$

£111 2 $2\frac{2}{3}$ *Anſ.*

7. To Livres Tournois.

Rule. Multiply the Engliſh pounds by $23\frac{1}{3}$, and the product will be livres.

Reduce £100 Engliſh to Livres Tournois.

100

$23\frac{1}{3}$

300

200

$33\frac{1}{3}$

Note.

1d. = $1\frac{17}{18}$ ſous.

1s. = $1\frac{1}{6}$ liv.

£1 = $23\frac{1}{3}$ liv.

liv. ſou. de.

$2333\frac{1}{3}$ liv. = 2333 6 8 *Anſ.*

VII. *To reduce Iriſh Money.*

1. To New-Hampſhire, Maſſachuſetts, Rhode-Iſland, Connecticut, and Virginia currency.

Rule. Multiply the Iriſh ſum by 16, and divide the product by 13.

Reduce £100 Iriſh to New-Hampſhire, &c.

100

4×4

400

4

13)1600

£123 1 $6\frac{6}{13}$ *Anſ.*

2. To New-Jerſey, Pennſylvania, Delaware, and Maryland currency.

Rule. Multiply the Iriſh ſum by 20, and divide the product by 13.

Reduce £100 Iriſh to New-Jerſey, &c.

```
    100
    ---
    4×5=20
   ---
   400
     5
   ---
13)2000(153 16 11 1/13 Anſ.
   13      11          12
   --      20          12
    70    ---         ---
    65 13)220(16  13)144(11
    --    13           13
    50    --           --
    39    90           14
    --    78           13
    11    --           --
          12            1
```

3. To Livres Tournois.

Rule. Multiply the Iriſh ſum, in pence, by 70; divide that product by 39, and the quotient will be ſous, which, divided by 20, will be livres.

Reduce £100 Iriſh to Livres Tournois.

100×20×12=24000d.

70

2,0

39)1680000(4307,6

ſou.

Anſ. Liv. 2153 $16\frac{12}{13}$

1d. is $1\frac{31}{39}$ ſous. 1s. is $21\frac{7}{13}$ ſo.

£1 is 21 livres, $10\frac{10}{13}$ ſous.

4. To Canada and Nova-Scotia currency.

Rule. To the Iriſh ſum add one thirty-ninth.

Reduce £100 Iriſh to Canada, &c.

39)100(2
78
22
20
39)440(11
39
50
39
11
12
39)132(3
117
$\frac{15}{39} = \frac{5}{13}$

100
+2 11 $3\frac{5}{13}$
£102 11 $3\frac{5}{13}$ *Anſ.*

5. To South-Carolina and Georgia currency.

Rule. Multiply the Iriſh ſum by 112, and divide the product by 117.

Reduce £100 Iriſh to South-Carolina, &c.

100
7×4×4=112
700
4
2800
4
£
117)11200(95 14 $6\frac{42}{117}$ *Anſ.*
1053
670
585
85

6. To New-York and North-Carolina currency.

Rule. Multiply the Iriſh ſum by 64, and divide the product by 39.

Reduce £100 Iriſh to New-York, &c.

100
8×8=64
800
8
£ s.
39)6400(164 $2\frac{2}{39}$ *Anſ.*
39
250
234
160
156
4

7. To Engliſh Money.

Rule. From the Iriſh ſum deduct one thirteenth.

Reduce £100 Iriſh to Engliſh money.

13)100(7
91
——
9
20
——
13)180(13
13
——
50
39
——
11
12
——
13)132(10
13
—
2

£.	s.	d.
100	0	0
—7	13	$10\frac{2}{13}$
£92	6	$1\frac{11}{13}$
		Anſ.

VIII. *To reduce Canada and Nova-Scotia currency.*

1. To New-Hampſhire, Maſſachuſetts, Rhode-Iſland, Connecticut and Virginia currency.

Rule. To the given ſum add one fifth.

Reduce £100 Canada, &c. to New-Hampſhire, &c.

5)100
+20
——
£120 *Anſ.*

2. To New-York and North-Carolina currency.

Rule. Multiply the given ſum by 8, and divide the product by 5.

Reduce £100 Canada, &c. to New-York, &c.

100
8
——
5)800
——
£160 *Anſ.*

3. To New-Jerſey, Pennſylvania, Delaware and Maryland currency.

Rule. To the given ſum add one half.

Reduce £100 Canada, &c. to New-Jerſey, &c.

2)100
+50
——
£150 *Anſ.*

4. To South-Carolina and Georgia currency.

Rule. From the given ſum deduct one fifteenth.

Reduce £100 Canada, &c. to South-Carolina, &c.

15=

15=3×5)100

3)20

—6 13 4

£93 6 8 *Anſ.*

5. To Engliſh Money.

Rule. From the given ſum deduct one tenth.

Reduce £100 Canada, &c. to Engliſh money.

10)100

—10

£90 *Anſ.*

6. To Iriſh Money.

Rule. From the given ſum deduct one fortieth.

Reduce £100 Canada, &c. to Iriſh money.

40)100

—2 10

£97 10

7. To Livres Tournois.

Rule. Multiply the given pounds by 21, and the product will be Livres.

Reduce £100 Canada, &c. to Livres Tournois.

100

7×3=21

700 1d.= 1¾ Sous.
3 1s.=21 Sous.
1l.=21 Liv.
2100 *Anſ.*

8. To Federal, or Spaniſh Dollars.

Rule. Reduce the given ſum to ſhillings: Divide them by 5. *Or*, Multiply the pounds by 4, and if there be ſhillings, turn them into dollars, and add them to the product.

Reduce £100 Canada, &c. to dollars.

100 155 15
20 4

5)2000 620

+3=15s.

D. 400 *Anſ.*

Dol. 623 *Anſ.*

IX. *To reduce Livres Tournois.*

1. To New-Hampſhire, Maſſachuſetts, Rhode-Iſland, Connecticut and Virginia currency.

Rule. Multiply the Livres by 2; divide the product by 35, and the quotient will be pounds: *Or*, Multiply the Livres by 8:

Divide the product by 7, and the quotient will be ſhillings.

Reduce 1750 Livres to New-Hampſhire, &c. currency.

```
 1750            Or, 1750
    2                   8
 ———£.           ————————
35)3500(100 Anſ. 7)14000
 35              ————————
 ———            2,0)200,0
  00             ————————
                    £100
                (as before.
```

2. To New-York and North-Carolina currency.

Rule. Multiply the Livres by 32: Divide the product by 21, and the quotient will be ſhillings.

Reduce 1312½ Livres to New-York, &c. currency.

```
     1312,5
         32
     ——————
     26250
    39375
  ——————————2,0
21)42000(200,0
        £100 Anſ.
```

3. To New-Jerſey, Pennſylvania, Delaware and Maryland currency.

Rule. Divide the Livres by 14, and the quotient will be pounds: *Or,* Multiply the Livres by 10: Divide the product by 7, and the quotient will be ſhillings.

Reduce 1400 Livres to New-Jerſey, &c. currency.

```
     1400
       10
   ———————        Or,      £
  7)14000      14)1400(100
   ———————          14
2,0)200,0           ——
    ————            ..00
 £100  Anſ.
```

4. To South-Carolina and Georgia currency.

Rule. Multiply the Livres by 2, divide the product by 45, and the quotient will be pounds. Or, deduct one ninth, and the remainder will be ſhillings.

Reduce 2250 Livres to South-Carolina, &c. currency.

```
   2250               Or,
      2            9)2250
 ————————£.          —250
45)4500(100 Anſ.  ————————
   45             2,0)200,0
   ——             —————————
   00                £100
                  (as before.
```

5. To Engliſh Money.

Rule. Deduct one ſeventh from the Livres, and the remainder will be ſhillings.

Reduce $2333\frac{1}{3}$ Livres to Engliſh money.

$7)2333\frac{1}{3}$
$-333\frac{1}{3}$
2|0)200|0
£100 *Anſ.*

6. To Iriſh Money.

Rule. Reduce the livres to ſous, then multiply them by 39: Divide this product by 70, and the quotient will be pence.

Reduce 2153 liv. $16\frac{12}{13}$ ſous, to Iriſh Money.

liv. ſous.
2153 $16\frac{12}{13}$
20
$43076\frac{12}{13}$
39
387720
129228
7,0)168000,0
12)24000
2,0)200,0
£100 *Anſ.*

7. To Federal or Spaniſh Dollars.

Rule. Multiply the livres by 4; divide the product by 21, and the quotient will be Spaniſh or Federal Dollars.

Reduce 1000 Livres to Dollars.

1000
4
21)4000(190 *Fed. or (Span. Dol.*
21
190
189
10
10
d. c. m.
21)100(4 7 $6\frac{4}{21}$

X. *To reduce Federal or Spaniſh Dollars.*

1. To New-Hampſhire, Maſſachuſetts, Rhode-Iſland, Connecticut and Virginia currency.

Rule. Multiply the Dollars by 3, and double the right hand figure of the product, for ſhillings; the left hand figures are pounds.

Reduce 529 Dollars to New-Hampſhire, &c.

529
3
£158 14 *Anſ.*

2. To New-York and North-Carolina currency.

Rule. Multiply the Dollars by 4; double the right hand figure of the product for ſhillings, and the left hand figures are pounds.

Reduce 529 Dollars to New-York, &c.

529
4

£211 12 *Anſ.*

3. To New-Jerſey, Pennſylvania, Delaware and Maryland currency.

Rule. Multiply the Dollars by 3, and divide by 8.

Reduce 529 Dollars to New-Jerſey, &c.

529
3
£.
8)1587(198 7 6 *Anſ.*
8

78
72

67
64

3

Or,
8)1587

£$198\frac{3}{8}$ *Anſ.*

4. To South-Carolina and Georgia currency.

Rule. Multiply the Dollars by 7, and divide by 30.

Reduce 529 Dollars to South-Carolina, &c.

529
7

3,0)370,3

£$123\frac{13}{30}$

*5. To Engliſh Money, at 4*s.* 6*d.* per Dollar.

Rule. Multiply the Dollars by 9, and divide by 40.

Reduce 529 Dollars to Engliſh money.

529
9

4,0)476,1

£$119\frac{1}{40}$

6. To Canada and Nova-Scotia currency.

Rule. Divide the Dollars by 4.

Reduce 529 Dollars to Canada, &c.

4)529

£$132\frac{1}{4}$ *Anſ.*

7. To Livres Tournois.

Rule. Multiply the Dollars by $5\frac{1}{4}$, and the product will be Livres: *Or*, Multiply them by 21, divide by 4, and the quotient will be Livres.

---

* *Note,* That in England Dollars are Bullion, that is, they are bought and ſold by weight, and their value varies as other articles of merchandiſe.

Reduce 100 Spanish Dollars to Livres.

	Or,
100	100
$5\frac{1}{4}$	21
500	
$100+\frac{1}{4}=25$	4)2100
Anſ. 525 *liv.*	525 *as before.*

NOTE,
1 Cent = $1\frac{1}{20}$ Sous.
1 Dime = $10\frac{1}{2}$ Sous.
1 Dollar = $5\frac{1}{4}$ Livres.

The pound	contains	Grains of fine Silver.
Sterling		$1718\frac{2}{3}$
New-Hampſhire, &c.		1289
New-York, &c.		$966\frac{3}{4}$
New-Jerſey, &c.		$1031\frac{1}{4}$
South Carolina, &c.		1657,366

	Grains of Stand. Silver.
Ditto,	1858
Ditto,	$1393\frac{1}{2}$
Ditto,	1045
Ditto,	$1114\frac{3}{4}$
Ditto,	1791,819

The proportion of alloy being $\frac{3}{37}$ of the fine Silver.

The Federal	contains	Grains of fine	
Dollar	375,64	Silver	409,78 grs. of Stand. Silver.
Eagle	246,268	Gold	268,659 grs. of Stand. Gold.

The alloy being $\frac{1}{11}$ of the fine Silver. Gold.

The Subdiviſions are in the ſame proportion.

RECAPITULATION

RECAPITULATION *of the*

Seek the given Coin in the left hand column, then caſt
required Coin, and you will have

		1	2	3	4	5
		New H. Maſ. R. I. Connect. Virginia.	New Jerſ. Pennſyl. Delaw. Maryl.	New York N. Carol	S. Carol Georgia.	Sterling.
1	NewH. Maſ. R. Conn. & Virg.		Add $3\frac{1}{4}$ Page 118.	Add $\frac{1}{3}$ Page 118.	Mult. by 7, divide Prod. by 9. P. 118	Deduct $\frac{1}{4}$ Page 118.
2	New J. Pennſ. Delaw. Maryl.	Deduct $\frac{1}{5}$ Page 121.		Add $\frac{1}{16}$ Page 121.	Mult. by 28, divide Prod. by 45. P. 121.	Mult. by 3. divide Prod. by 5. P. 121.
3	New Y. and N. Car.	Deduct $\frac{1}{4}$ Page 123.	Ded. $\frac{1}{13}$ Page 123.		Mult. by 7, & div. Prod. by 12. P. 123.	Mult. by 9, & div Prod. by 16. P. 123.
4	S. Car. and Georg.	Mult. by 9, & div. Prod by 7 Page 125.	Mult. by 45, & div. Prod. by 28. P. 125	Mult. by 12, & div. by 7. Page 125.		Ded. $\frac{1}{28}$ Page 125.
5	Sterl.	Add $\frac{1}{3}$ Page 127.	Mult. by 5, and div. Prod. by 3. P. 127.	Mult. by 16, & div. Prod. by 9. P. 127.	Add $\frac{1}{27}$ Page 127	
6	Iriſh.	Mult. by 6, & div. Prod. by 13. P. 128.	Mult. by 20, & div. by 13. Page 128.	Mult. by 64, & div. by 39. Page 129.	Mult. by 112, & div. by 117. Page 129.	Ded. $\frac{1}{13}$ Page 130.
7	Canada and Nova-Scotia.	Add $\frac{1}{5}$ Page 130	Add $\frac{1}{2}$ Page 130.	Mult. by 8, and div. Prod. by 5. Page 130.	Ded. $\frac{1}{15}$ Page 129.	Ded. $\frac{1}{10}$ Page 131.
8	Livres Tourn.	Mult. by 2 div. by 35; or by 8, & 1.7 & q is *s*.	Divide by 14. Page 132.	M. by 32, div. by 21, and quo. is ſhillings.	Deduct $\frac{1}{9}$ and rem. is ſhills. Page 132.	Deduct $\frac{1}{7}$ and rem is ſhills. Page 132
9	Fed'ra or Span. Dollars	M 3, dou. rt hd. pro. for *s*. left are poun.	Mult. by 3, & div. Prod by 8. Page 134.	M. 4, dou. rt. hd. Pro. f. for s. left are poun.	Mult. by 7, & div. Prod. by 30. P. 134.	Mult. by 9, & div. by 40. Page 134

preceding RULES *of* EXCHANGE.

your eye to the right hand, till you come under the
the Rule, with the Reference.

6	7	8	9
Iriſh.	Canada. Nova-Scot.	Livres Tournois.	Federal or Spaniſh Dollars.
Multip. by 13, div. by 16. Page 119.	Multiply by 5, div. by 6. Page 119.	Multiply by 17½. Page 119.	If £'s. only annex a 0, & di. by 3. If £s & *s.* an. half *s.* & div. as bef. q. is d. re. *s.* &c.
Multip. by 13, divide Prod. by 20. Page 121.	Deduct $\frac{1}{3}$. Page 122.	Multiply by 14. Page 122.	Multiply by 2⅔. Page 122.
Multip. by 39, & div. Prod. by 64. Page 123.	Multiply by 5, & divide by 8. Page 124.	Multiply the ſum in ſhils. by 21 divide Product by 32. Page 124.	If £'s. only annex a 0, & di. by 4. If £s. & *s.* an. half the *s.* & div. as before. P. 124
Multip. by 117, & div. Prod. by 112, Page 126.	Multiply by 15, & div. by 14. Page 126.	Multiply pounds by 22½. Page 126.	Mult. pounds by 30, div. Prod. by 7, & if any *s.* turn them to dols. & add them.
Add $\frac{1}{12}$ Page 127.	Add $\frac{1}{9}$ Page 127.	Multiply pounds by 23⅓. Page 128.	Mult. by 40, divide Prod. by 9, & the rem. is ſix pences.
	Add $\frac{1}{39}$ Page 129.	Mult. the ſum in pence by 70, div. by 39, & quo. is *s.* which div. by 20.	M. by 160. di. pro. by 39, q. is dol. & unit in rem. is 1½d. Iriſh or 2 cents nearly.
Deduct $\frac{1}{40}$ Page 131.		Multiply by 21. Page 131.	Multiply by 4. Page 131.
Re. them to ſhil. M. by 39, div. by 70, & q. is *d*	Deduct $\frac{1}{21}$ and the remainder is hillings.		Multiply by 4, and divide Product by 21. Page 133.
Div. by 4 & ded. $\frac{1}{40}$ of the quotient.	Div. by 4. Page 134	Multiply by 5¼. Page 134.	

The Standard WEIGHT of an EAGLE 11 pwt. 4$\frac{2}{3}$ grs.—Half ditto, 5 pwt. 14$\frac{1}{3}$ grs.—A DOLLAR 17 pwt. 1$\frac{3}{4}$ grs.—Half ditto, 8 pwt. 12$\frac{7}{8}$ grs.—A DOUBLE DIME 3 pwt. 9$\frac{4}{5}$ grs.—A DIME 1 pwt. 16$\frac{9}{10}$ grs.

TABLE *of the value of ſeveral Pieces of Coin, in the* FEDERAL COIN, *and the ſeveral Currencies of the* UNITED STATES.

	Federal Coin.	N. Hampſhire, Maſſachuſetts. R. Iſland, Connecti. Virginia.			N. York and N. Carolina.			N. Jerſey, Pennſylvania, Delaware and Maryland.			South-Carolina and Georgia.		
	Cents.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
$\frac{1}{16}$ of a Doll	0,06$\frac{1}{4}$			4$\frac{1}{2}$			6			$\frac{5}{8}$			3$\frac{1}{2}$
$\frac{1}{2}$ a Piſtareen	0,10			7$\frac{1}{5}$			9$\frac{3}{5}$			9			5$\frac{3}{5}$
		Vir.		8									
$\frac{1}{9}$ of a Doll.	0,11$\frac{1}{9}$			8			10$\frac{2}{3}$			10			6$\frac{2}{9}$
$\frac{1}{8}$ of ditto.	0,12$\frac{1}{2}$			9		1	0			11$\frac{1}{5}$			7
A Piſtareen	0,20		1	2$\frac{2}{5}$		1	4$\frac{1}{2}$		1	6			11$\frac{1}{5}$
		Vir.	1	4									
Eng. Shill.	0,21$\frac{2}{9}$		1	4		1	7$\frac{2}{3}$		1	8		1	0$\frac{4}{9}$
$\frac{1}{4}$ of a Doll.	0,25		1	6		2	0		1	10$\frac{1}{2}$		1	2
Half ditto	0,50		3	0		4	0		3	9		2	4
A Dollar.	1,00		6	0		8	0		7	6		4	8
Eng Crown	1,11$\frac{1}{9}$		6	8	*N.Y.*	9	0		8	4		5	2$\frac{2}{9}$
					N.C.	8	9						
pw. gr													
Fr.G. 5 5	4,62$\frac{26}{27}$	1	7	6	1	16	0	1	14	6	1	1	5
In Maſſ. 5 6	4,55$\frac{1}{9}$	1	7	4									
En. Gu. 5 6	4,66$\frac{2}{3}$	1	8	0	1	17	0	1	15	0	1	1	9
In S.C. 5 7											1	1	10
$\frac{1}{2}$ Joha. 9 0	8,00	2	8	0	3	4	0	3	0	0	1	17	4
Piſtole 4 5 In Maſſ 4 3	)3,66$\frac{2}{3}$	1	2	0	1	8	0	1	7	0		17	6
Moid. 6 18	6,00	1	16	0	2	6	0	2	5	0	1	8	0
Doub. 17 0	14,66$\frac{2}{3}$	4	8	0	5	16	0	5	12	0	3	10	0

CROSS MULTIPLICATION;

Or,

DUODECIMALS,

Is a Rule made uſe of by Workmen and Artificers, in caſting up the contents of their works.

Dimenſions are generally taken in feet, inches and parts.

Inches and parts are ſometimes called primes, ſeconds, thirds, &c. and are marked thus; inches or primes ('), ſeconds ("), thirds ('''), fourths (''''), &c.

This method of multiplying is not confined to *twelves*; but may be greatly extended: For any number, whether its inferiour denominations decreaſe from the integer in the ſame ratio, or not, may be multiplied croſſwiſe.

Rule 1.—Under the multiplicand write the correſponding denominations of the multiplier.

2. Multiply each term in the multiplicand, beginning at the loweſt, by the higheſt denomination in the multiplier, and write the reſult of each, under its reſpective term, obſerving in duodecimals, to carry a unit for every 12, from each lower denomination to its next ſuperiour, and for other numbers accordingly.

3. In the ſame manner multiply all the multiplicand by the primes or ſecond denomination in the multiplier, and ſet the reſult of each term one place removed to the right hand of thoſe in the multiplicand.

4. Do the ſame with the ſeconds in the multiplier, ſetting the reſult of each term two places to the right hand of thoſe in the multiplicand.

5. Proceed in like manner with all the reſt of the denominations, and their ſum will be the anſwer required.

Examples.

EXAMPLES.

1. Multiply $2\frac{1}{2}$ feet by $2\frac{1}{2}$ feet.

F. ′
2 6
2 6
———
5 0
1 3 0
———
6 3 *Anſ.*

Or, thus.
$2\frac{1}{2}$
$2\frac{1}{2}$
———
5
$1\frac{1}{4}$
———
Anſ. $6\frac{1}{4}$ ſquare feet=6 feet, 36 inches.
So that the 3 is not 3 inches,
but 36 inches, or $\frac{1}{4}$ of a ſquare foot.

Or, thus,
2, 5
2, 5
———
125
50
———
Anſ. 6,25 Square Feet.

2. Multiply 9f. 8′ 6″ by 7f. 9′ 3″.

f. ′ ″
9 8 6
7 9 3
———
67 11 6 = Product by the feet in the multiplier.
7 3 4 6‴ = ditto by the primes.
2 5 1 6⁗ = ditto by the ſeconds.
———
75 5 3 7 6 *Anſ.*

3. How many ſquare feet in a board 17 feet 7 inches long, and 1 foot 5 inches wide?

Anſ. 24f. 10′ 11″

4. How many cubic feet in a ſtick of timber 12 feet 10 inches long, 1 foot 7 inches wide, and 1 foot 9 inches thick?

Anſ. 35f. 6′ 8″ 6‴

The two following queſtions are Sexceſſimals.

5. If two places differ in longitude 2° 12′; what is their difference of time?

Mult. 2° 12′ 00″ 00‴
by 3′ 59″ 20‴ the time in which the Sun paſſes (through 1 degree.
———
8′ 46″ 32‴ *Anſ.*

6. Two places differ in longitude 31° 27′ 30′—what is the difference. in time, of the Sun's coming to the meridian of thoſe places, the Sun paſſing through 15° in an hour?

31° 37′ 30″
4′ 00″ In 4′ of a ſolar day, or a day of 24 hours,
——— (the Sun paſſes 1 degree.
2 6′ 30″ 00‴ *Anſ.*

SINGLE RULE OF THREE DIRECT.

The Rule of Three Direct teacheth, by having three numbers given, to find a fourth, that ſhall have the ſame proportion to the third, as the ſecond hath to the firſt.

If *more* require *more*, or *leſs* require *leſs*, the queſtion belongs to the Rule of Three Direct.

But if *more* require *leſs*, or *leſs* require *more*, it belongs to the Rule of Three Inverſe.*

Rule† 1.—State the queſtion by making that number, which aſks the queſtion, the third term, or putting it in the third place: That, which is of the ſame name or quality as the demand, the firſt term; and that, which

is

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* *More* requiring *more*, is, when the third term is greater than the firſt, and requires the fourth term to be greater than the ſecond. And *leſs* requiring *leſs*, is, when the third term is leſs than the firſt, and requires the fourth term to be leſs than the ſecond.

Alſo, *more* requiring *leſs*, is, when the third term is greater than the firſt, and requires the fourth term to be leſs than the ſecond. And *leſs* requiring *more*, is, when the third term is leſs than the firſt, and requires the fourth term to be greater than the ſecond.

† This Rule, on account of its great and extenſive uſefulneſs, is ſometimes called the *Golden Rule of Proportion*; for, on a proper application of it and the preceding rules, the whole buſineſs of Arithmetic, as well as every mathematical inquiry, depends. The rule itſelf is founded on this obvious principle, that the magnitude or quantity of any effect varies conſtantly in proportion to the varying part of the cauſe: Thus, the quantity of goods, bought, is in proportion to the money laid out;—the ſpace, gone over by a uniform motion, is in proportion to the time, &c.

It

is the ſame name or quality with the anſwer required, the ſecond term.

2. Multiply the ſecond and third numbers together; divide the product by the firſt, and the quotient will be the anſwer to the queſtion, which (as alſo the remainder) will be in the ſame denomination you left the ſecond term in, and which may be brought into any other denomination required.

Two or more ſtatings, are ſometimes neceſſary, which may always be known from the nature of the queſtion.

The method of proof is by inverting the queſtion.

EXAMPLES.

It has been ſhown in Multiplication of Money, that the price of one, multiplied by the quantity, is the price of the whole; and in Diviſion, that the price of the whole divided by the quantity, is the price of one: Now, in all caſes of valuing goods, &c. where one is the firſt term of the proportion, it is plain, that the anſwer, found by this rule, will be the ſame as that, found by Multiplication of Money, and where one is the laſt term of the proportion, it will be the ſame as that, found by Diviſion of Money.

In like manner, if the firſt term be any number whatever, it is plain that the product of the ſecond and third terms will be greater than the true anſwer required, by as much as the price in the ſecond term exceeds the price of one, or as the firſt term exceeds a unit; conſequently, this product, divided by the firſt term, will give the true anſwer required.

Note 1. When it can be done, multiply and divide as in Compound Multiplication, and Compound Diviſion.

2. If the firſt term, and either the ſecond or third can be divided by any number without a remainder, let them be divided, and the quotient uſed inſtead of them.

The following methods of operation, when they can be uſed, perform the work in a much ſhorter manner than the general rule.

1. Divide the ſecond term by the firſt; multiply the quotient into the third, and the product will be the anſwer.

2. Divide the third term by the firſt; multiply the quotient into the ſecond, and the product will be anſwer.

3. Divide the firſt term by the ſecond, and the third by that quotient, and the laſt quotient will be the anſwer.

4. Divide the firſt term by the third, and the ſecond by that quotient, and the laſt quotient will be the anſwer.

EXAMPLES.

1. If 6lb. of ſugar coſt 9s. what will 30lb. coſt at the ſame rate?

Here, the firſt clauſe (if 6lb. of ſugar coſt 9s.) ſuppoſes the rate; then follows the queſtion; What will 30lb. coſt?

30lb. which moves the queſtion, is the third term. —6lb. the ſame kind, is the 1ſt—and 9 ſhillings the 2d.

lb. s. lb.
As 6 : 9 :: 30 : the *Anſ.*
9
6)270
Anſ. 45s.=£2 5s.

Again—By inverting the order of the queſtion, it will be,

2. If 9s. buy 6lb. of ſugar, how much will £2 5s. buy at that rate?

s. lb. s.
As 9 : 6 :: 45 : the *Anſ.*
6
9)270
30lb. *Anſ.*

Again 3. If 30lb. of ſugar be worth £2 5s. how much may I buy for 9s.?

As

Note. The term which aſks or moves the queſtion, has generally ſome words like theſe before it, viz. What will? What coſt? How many? How far? How long? or, How much? &c.

OBSERVATIONS.

1. The fourth number is always found in the ſame name in which the ſecond is given, or reduced to; which, if it be not the higheſt denomination of its kind, reduce to the higheſt, when it can be done.

2. When the ſecond number is of divers denominations, bring it to the loweſt mentioned, and the fourth will be found in the ſame name to which the ſecond is reduced, which reduce back to the higheſt poſſible.

3. If the firſt and third be of different names, or one or both of divers denominations, reduce them both to the loweſt denomination mentioned in either.

4. When the product of the ſecond and third is divided by the firſt; if there be a remainder after the diviſion, and the quotient be not the leaſt denomination of its kind; then multiply the remainder by that number, which one of the ſame denomination

s. lb. s.
As 45 : 30 :: 9 : the *Anſ.*
9
——
45)270(6lb. *Anſ.*
270

Again 4. Suppoſe £2 5s. will buy 30lb. of ſugar: What will 6lb. of the ſame ſugar coſt?

lb. s. lb.
As 30 : 45 :: 6 : the *Anſ.*
6
——
3|0)27|0
9s.
——

N. B. The three laſt queſtions are only the firſt *varied*, being purely to ſhow how any queſtion in this rule may be inverted.

5. If 5yds. of cloth coſt £1 10s. what will 20yds. ditto come to?

£1 10s.
yds. s. yds. 20
As 5 : 30 :: 20 ——
30÷ 5 = 6 5)30s.
—— 6 *Quo.*
2,0)12,0s =£6 *Anſ.*

Here I divide the 2d term by the 1ſt, and multiply the quotient into the 3d, for the anſwer.

yds. s. yds.
Again 6. As 5 : 30 :: 20
20÷5 = 4
——
120s.=£6.

Here, I divide the 3d term by the 1ſt, and multiply the quotient into the 2d, for an anſwer.

7. If 20yds coſt £120, how many yds. may I have for £30?

£. yds. £.
As 120 : 20 :: 30
120÷20=6 Quotient &
30÷ 6=5 yds. *Anſ.*

Here, I divide the 1ſt term by the 2d, and then the 3d term by that quotient for the anſwer.

Again, £. yds. £.
8. As 120 : 20 :: 30
120÷30=4 Quotient,
20÷ 4=5 yds. *Anſ.*

Here, I divide the 1ſt term by the 3d, and then the 2d term by that quotient for the anſwer.

9. If

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denomination with the quotient contains of the next leſs, and divide this product again by the firſt number; and thus proceed, till the leaſt denomination be found, or till nothing remain.

5. If the firſt number be greater than the product of the ſecond and third; then bring the ſecond to a lower denomination.

6. When

9. If 1 Cwt. of tobacco coſt £5 12 9½; what will 8 Cwt. ditto coſt?

	Cwt.		£.	s.	d.		Cwt.
As	1	:	5	12	9½	::	8
					8		
Anſ.			£45	2	4		

Here is no need of reducing the middle term; becauſe it can be performed by compound multiplication, the firſt term being a unit.

10. If 8 Cwt. of tobacco coſt £45 2s. 4d. what is that per Cwt.?

	£.	s.	d.
8)	45	2	4
Anſ.	£5	12	9½

Here, there is no need of reducing the middle term, becauſe it may be performed by compound diviſion only, the 3d term being an unit.

11. If 57yds. coſt £69, what will 9yds. coſt at that rate?

	yds.		£.		yds.
As	57	:	69	::	9
			9		

57)621(10£ *Anſ.*
57
51
20
57)1020(17s.
57
450
399
51
12
57)612(10d.
57
42
4
57)168($2\frac{54}{57}$ qrs.
114

Here, all the terms being whole numbers, there is no need of reducing the middle one till after ſtating.

12. If

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6. When any number of barrels, bales, or other packages or pieces are given, each containing an equal quantity, let the contents of one be reduced to the loweſt name, and then multiplied by the given number of packages or pieces

7. If the given barrels, bales, pieces, &c. be of unequal contents, (as it moſt generally happens) put the ſeparate content of each properly under one another, then add them together, and you will have the whole quantity.

12. If 9C. 3qr. ſugar coſt £27 17s. 6d. what will 2C. 1qr. 11lb. coſt?

```
9C. 3qrs.    £27   17s. 6d.    2C.  1qr. 11lb.
 4             20                4
——           ———               ——
 39           557                9
 28            12               28
———          ———              ———
312          6690               73
78                              19
———                            ———
1092                            263
```

```
      lb.       d.        lb.
As 1092 : 6690 :: 263 : the Anſwer.
               263
              ————
              2007
              4014
              1338
         ——————————  12
1092)1759470(1611
     1092    ————
     ————  2|0)13|4  3d.
     6674   £6 14  3d. Anſwer.
     6552
     ————
      1227
      1092
      ————
       1350
       1092
       ————
        258
          4
       ————
1092)1032(0qr.
       ————
```

Note 1. If you look at the ſtating, you will ſee that the firſt and third terms are of the ſame kind, but of different denominations, and therefore are reduced to the ſame name or denomination, and, that the demand of the queſtion lies on the third term.

2. That the middle term, being given in pounds, ſhillings and pence, is reduced to pence.

13. If my income be 109 guineas *per annum*, I

deſire to know what I may ſpend per day, ſo that I may lay up £45 at the year's end?

Anſ. £0 5 10$\frac{3}{4}$ $\frac{1}{365}$ *per day.*

Note 1. You muſt ſubtract £45 from the value of 109 guineas.

2. There being 365 days in a year, your queſtion muſt next be ſtated thus:

D. Guin. £. D.
As 365 : 109—45 :: 1 : *the Anſwer.*

14. If my ſalary be £43 12s. 5d. per annum, what does it amount to per week?

D. £. s. d. D.
As 365 : 43 12 5 :: 7 : 16s 8$\frac{3}{4}$d. *Anſ.*

15. Suppoſe my income to be 16s. 8$\frac{3}{4}$d. per week, what is it per annum?

Anſ. £43 12 5.

D. s. d. D.
As 7 : 16 8$\frac{3}{4}$ :: 365 : *the Anſwer.*

16. If I am to pay 1s. 7d. per week for paſturing a cow; what muſt I give per week for 37 cows?

C. s. d. C. £. s. d.
As 1 : 1 7 :: 37 : 2 18 7 *Anſ.*

17. How many yards of cloth may be bought for £57 13, whereof 9$\frac{1}{2}$ yards coſt £3 15s. 5$\frac{1}{2}$d.?

£. s. d. Yds. £. s. Yds. qr. n.
As 3 15 5$\frac{1}{2}$: 9$\frac{1}{2}$ :: 57 13 : 145 0 2$\frac{2004}{3622}$ *Anſ.*

18. If I buy 57 yards of cloth for 49 guineas; what did it coſt per ell Engliſh?

Yds. Guin. Yds.
As 57 : 49 :: 1$\frac{1}{4}$: £1 10s. 1$\frac{12}{128}$d. *Anſ.*

19. A merchant, failing in trade, owes in all £3475, and has, in money and effects, but £2316 13s. 4d.; Now, ſuppoſing his effects are delivered up; pray, what will each creditor receive on the pound?

£. £. s. d. £.
As 3475 : 2316 13 4 :: 1 : £0 13s. 4d. *Anſ.*

20. A owes B £3475; but B compounds with him for 13s. 4d. on the pound; pray, what muſt he receive for his debt?

£. s. d. £. £. s. d.
As 1 : 13 4 :: 3475 : 2311 13 4 *Anſwer.*

21. If the diſtance from Newburyport to York be 31 miles; I demand, how many times a wheel, whoſe circumference is $15\frac{1}{2}$ feet, will turn round in performing the journey?

Feet. Cir. M. Cir.
As $15\frac{1}{2}$: 1 :: 31 : 10560 *times, Anſwer.*

22. Bought 9 cheſts of tea, each weighing 3C. 2qrs. 21lb. at £4 9s. per Cwt. what came they to?

Cwt. £. s. C. qr. lb. £. s. d.
As 1 : 4 9 :: 3 2 21×9 : 147 13 $8\frac{1}{4}$.

23. What will $37\frac{1}{2}$ groſs of buttons, at $9\frac{1}{2}$d. per dozen, come to?

Doz. d. Groſs. £. s. d.
As 1 : $9\frac{1}{2}$ :: $37\frac{1}{2}$: 17 16 3 *Anſwer.*

24. A farm, containing 125A. 3R. 27P. is rented at £3 9s. per acre; what is the yearly rent of that farm?

A. £. s. A. R. P. £.
As 1 : 3 9 :: 125 3 27 : 434 8/$4\frac{1}{2}$ $\frac{144}{160}$ *Anſ.*

25. If a ſhip coſt £537; what are $\frac{3}{8}$ of her worth?

Eigh. £. Eigh. £. s. d.
As 8 : 537 :: 3 : 201 7 6 *Anſwer.*

26. If $\frac{7}{16}$ of a ſhip coſt £349; what is the whole worth?

Sixt. £. Sixt. £. s. d.
7 : 349 :: 16 : 797 14 $3\frac{1}{4}$ $\frac{5}{7}$ *Anſwer.*

27. Bought a caſk of wine at 4/7 per gallon, for 125 dollars; how much did it contain?

s. d. Gal. Dol. Gal. qt. pt.
As 4 7 : 1 :: 125 : 163 2 $1\frac{1}{11}$ *Anſwer.*

28. What comes the inſurance of £537 15s. to, at £$4\frac{1}{2}$ per centum?

£. £. £. s. £. s. d.
As 100 : $4\frac{1}{2}$ :: 537 15 : 24 3 $11\frac{1}{2}$ $\frac{4}{5}$ *Anſ.*

29. What comes the commiſſion of £785 to, at $3\frac{1}{2}$ guineas per cent.?

£. Guin. £. £. s. d.
As 100 : $3\frac{1}{2}$ :: 785 : 38 9 $3\frac{1}{2}$ $\frac{2}{5}$ *Anſwer.*

30. A merchant bought 9 packages of cloth, at 3 guineas for 7 yards; each package contained 8 parcels; each parcel, 12 pieces; and each piece, 20 yards; what came the whole to, and what per yard?

Yds. Guin. Pack. £.
As 7 : 3 :: 9 : 10368 *Anſ. for the whole coſt.*

Yds. Guin. Yd.
As 7 : 3 :: 1 : £0 12s. *Anſwer per yard.*

31. A merchant bought 49 tuns of wine for £273; freight coſt £27—duties £12—cellar £9 10s. other charges £15, and he would gain £55 10s. by the bargain; what muſt I give him for 23 tuns?

Tuns. £. £. £. £. s. £. £. s. Tuns. £.
As 39 : 273+27+12+9 10+15+55 10 :: 23 : 184 *Anſ.*

32. If £100 gain £6 in a year, what will £475 gain in that time?

As £100 : £6 :: £475 : £28 10s. *Anſwer.*

33. The earth being 360 degrees in circumference, turns round on its Axis in 24 hours; how far does it turn in one minute, in the 43d parallel of Latitude: The degree of Longitude in this Latitude being about 51 ſtatute miles?

H. D. M. M. Miles.
As 24 : 360 × 51 : 1 : $12\frac{3}{4}$ *Anſwer.*

34. Shipped for the Weſt-Indies 225 quintals of fiſh, at 15/6 per quintal; 37000 feet of boards, at $8\frac{1}{3}$ dollars per 1000; 12000 ſhingles, at a half guinea per 1000; 19000 hoops, at $1\frac{1}{8}$ dollar per 1000, and 53 half joes; and, in return I have had 3000 gallons of rum, at 1s. 3d. per gallon; 2700 gallons of molaſſes, at $5\frac{1}{2}$d. per gallon; 2500lb. of coffee, at $8\frac{1}{2}$d. per lb. and 19 Cwt. of ſugar, at 12s. 3d. per Cwt. and my charges on the voyage were £37 12s. Pray, did I gain or loſe, and how much, by the voyage?

Anſ. loſt £134 9. 9d.

35. If a ſtaff, 4 feet long, caſt a ſhade (on level ground) 7 feet; what is the height of that ſteeple,

whoſe ſhade, at the ſame time, meaſures 198 feet?

F. Sh. ft. hei. F. Sh. ft. hei.
As 7 : 4 :: 198 : 113$\frac{1}{7}$ *Anſwer.*

36. *Suppoſe a tax of £755 be laid on a town, and the inventory of all the eſtates in the town amounts to £9345, what muſt A pay, whoſe eſtate is £149?

£. £. £. £.
As 9345 : 755 :: 149 : 12 0 9$\frac{1095}{9345}$ *Anſwer.*

37. If 50 gallons of water, in one hour, fall into a ciſtern, containing 230 gallons, and by a pipe in the ciſtern 35 gallons run out in an hour; in what time will it be filled?

Gal. Gal. H. Gal. H.
As 50—35 : 1 :: 230 : 15$\frac{1}{3}$ *Anſwer.*

38. A Butcher went with £416, to buy cattle: Oxen at £22 each, cows at £4, ſteers at £3 10s. and calves at £2 10s. and of each a like number; how many of each could he purchaſe with that ſum?

£. £. £. s. £. s. each. £. each.
As 22+4+3 10+2 10 : 1 :: 416 : 13 *Anſwer.*

39. Said Harry to Dick, my purſe and money are worth 3$\frac{1}{4}$ guineas; but the money is worth eleven

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* It may not be amiſs to ſhow the general method of aſſeſſing town or pariſh taxes.

Firſt, then, an inventory of the value of all the eſtates, both real and perſonal, and the number of polls, for which each perſon is rateable, muſt be taken in ſeparate columns: The moſt conciſe way is, then, to make the total value of the inventory the firſt term; the tax to be aſſeſſed, the ſecond; and £1 the third, and the quotient will ſhow the value on the pound. 2dly—Make the table, by multiplying the value on the pound by 1, 2, 3, 4, &c—3dly—From the inventory take the real and perſonal eſtates of each man, and find them ſeparately, in the table; which will ſhow you each man's proportional ſhare of the tax for real and perſonal eſtates.

Note. If any part of the tax is averaged on the polls, or otherwiſe, before ſtating, to find the value on the pound, you muſt deduct the ſum of the average tax from the whole ſum to be aſſeſſed: For which average, you muſt have a ſeparate column, as well as for the real and perſonal eſtates.

EXAMPLE.

times as much as the purſe ; pray, how much money is there in it ?

Guin. s. d.

As 12 : 1 :: $3\frac{1}{4}$: 7 7. *Then* £4 11s.—7*ſ*7=£4 3*ſ*5 *Anſ.*

40. How many dozen pair of gloves, at 13 groats per pair, may I have for 125 dollars ?

gr. pr. dol. doz. pr.

As 13 : 1 :: 125 : 14 $5\frac{4}{52}$ *Anſwer.*

41. There is a ciſtern, having 4 cocks ; the firſt will empty it in 10 minutes ; the ſecond, in 20 minutes ; the third, in 40, and the fourth, in 80 minutes : In what time will all four, running together, empty it ?

$$\text{As}\left\{\begin{matrix}10\\20\\40\\80\end{matrix}\right\}\overset{\text{Ciſt.}}{:}\ 1 :: \overset{\text{Min.}}{60} : \left\{\begin{matrix}6\\3\\1\frac{1}{2}\\\frac{3}{4}\end{matrix}\right\}\quad \overset{\text{Ciſt.}}{\text{As } 11\tfrac{1}{4}} : \overset{\text{Min.}}{60} :: \overset{\text{Ciſt.}}{1} : \overset{\text{Min.}}{5\tfrac{1}{3}}\ \textit{Anſ.}$$

$11\frac{1}{4}$ Ciſt.

42. A and B depart from the ſame place, and travel the ſame road ; but A goes 5 days before B, at the rate of 20 miles per day ; B follows at the rate of 25 miles per day : In what time and diſtance will he overtake A ?

M. M. D. M. D. D.

As 25—20 : 1 :: 20 × 5 : 20

D. M. D. M.

And, As 1 : 25 :: 20 : 500

43. If

E X A M P L E.

Suppoſe the General Court ſhould grant a tax of £100000, of which the town of Newburyport is to pay £1321 17s. 6d. and of which the polls, being 750, are to pay 5s. 3d. each ;—the town's inventory amounts to £45000 ; what will it be on the pound ; and what is A's tax, whoſe eſtate, (as by the inventory) is as follows, viz. real £376, perſonal £149, and he has 3 polls ?

Pol. s. d. Pol. £. s. d.

Firſt, As 1 : 5 3 :: 750 : 196 17 6 the average part of the tax to be deducted from £1321 17s. 6d. and there will remain £1125.

£. £. £.

Secondly, As 45000 : 1125 :: 1 : 6d. on the pound.

TABLE,

43. If the earth revolves 366 times in 365 days, in what time does it perform one revolution?

Rev. Days. Rev.
As 366 : 365 :: 1 : 23h. 56′ 3″ 56‴ + = 1
(Siderial day.*

44. If the earth makes one complete revolution in 23h. 56′ 3″ +, in what time does it paſs through one degree?
As 366° : 23h. 56′ 3″ :: 1° : 3′ 59″ 20‴ *Anſwer.*

45. If the earth performs its diurnal revolution in a Solar† day, or 24 hours; in what time does it move one degree?
As 360° : 24h. : 1° : 4′ *Anſwer.*

46. Sold

TABLE.

£.		£.	s.	d.	£.		£.	s.	d.	£.		£.	s.	d.
1	is	—	0	6	20	is	0	10	—	200	is	5	—	—
2	—	—	1	0	30	—	0	15	—	300	—	7	10	—
3	—	—	1	6	40	—	1	—	—	400	—	10	—	—
4	—	—	2	0	50	—	1	5	—	500	—	12	10	—
5	—	—	2	6	60	—	1	10	—	600	—	15	—	—
6	—	—	3	0	70	—	1	15	—	700	—	17	10	—
7	—	—	3	6	80	—	2	—	—	800	—	20	—	—
8	—	—	4	0	90	—	2	5	—	900	—	22	10	—
9	—	—	4	6	100	—	2	10	—	1000	—	25	—	—
10	—	—	5	0										

Now, to find what A's rate will be.

His real eſtate being £376; I find,

by the table, that £300 is	£7	10s.	
that £70 is - - - -	1	15	
and that £6 is - - -		3	
Therefore, his real eſtate is	£9	8	
In like manner, I find the tax for perſonal eſtate to be	3	14	6d.
His 3 polls, at 5s. 3d. each, are		15	9
	£13	18	3

Real.			Perſonal.			Polls.			Total.		
£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
9	8	0	3	14	6	0	15	9	13	8	3

---

* A Siderial day is the ſpace of time which happens between the departure of a Star from, and its return to the ſame meridian again.

† The Solar day is that ſpace of time which intervenes between the Sun's departing from any one meridian to the ſame again.

46. Sold a cargo of flax ſeed in Ireland, for £1795 10s. Iriſh money; what does that amount to in Maſſachuſetts currency, £81 5s. Iriſh being equal to £100 Maſſachuſetts?

Iriſh. Maſſ. Iriſh. Maſſ.
As £81¼ : £100 :: £1795½ : £2209 16s. 11d. *Anſ.*

Or, As 13 : 1795½ :: 16 : £2209 16s. 11d. as before, becauſe £13 Iriſh are equal to £16 Maſſachuſetts.

47. My correſpondent in Maryland purchaſed a cargo of flour for me, for £437 that currency; how much Maſſachuſetts money muſt I remit him, £125 Maryland being equal to £100 Maſſachuſetts?

As £125 : £100 :: £437 : £349 12s. *Anſ.*

£. £. s.
Or, As 5 : 437 :: 4 : 349 12 { Becauſe £5 Maryland are equal to £4 Maſſachuſetts.

48. A bill of exchange was accepted at Newburyport for the payment of £345 10, for the like value delivered in New-York, at £133⅓ New-York currency for £100 Maſſachuſetts ditto; how much money was paid in New-York, £75 Maſſachuſetts being equal to £100 of New-York?

£. Maſſ. £. N.Y. £. Maſſ. £. N.Y.
As 75 : 100 :: 345 10 : 460 13 4 *Anſ.*

49. When the exchange from Maſſachuſetts to Georgia is £83⅓ Georgia per £100 Maſſachuſetts, how much Maſſachuſetts money muſt be paid in Boſton to balance £457 Georgia currency?

£. Geor. £. Maſſ. £. Geor. £. Maſſ.
As 83⅓ : 100 :: 457 : 548 8s. *Anſ.*

50. A merchant delivered at Boſton £320 Maſſachuſetts currency, to receive £400 in Philadelphia; what was the Maſſachuſetts pound valued at?

B. P. B. P.
As £320 : £400 :: £1 : £1 5s. *Anſwer.*

£. £. £. £. s.
Or, As 80 : 100 :: 1 : 1 5 { Becauſe £80 Maſſachuſetts are equal to £100 Pennſylvania.

51. If I draw a bill of exchange for £537 10s. 6d. Maſſachuſetts, to be paid in Ireland, at £$123\frac{1}{13}$ Maſſachuſetts, per £100 Iriſh; for how much Iriſh money muſt I draw the bill?

	Maſſ.		Iriſh.		Maſſ.		Iriſh.
As	£$123\frac{1}{13}$	:	£100	::	£537 10/6	:	£436 14/$9\frac{1}{4}$

	£.		£.		£.		£.	
Or, As	16	:	537 10/6	::	13	:	436 14/$9\frac{1}{4}$	Becauſe £16 Maſſ. are=£13 Iriſh.

52. Suppoſe a bill is drawn in Ireland, and payable in Boſton, for £673 12s. 6d. Iriſh; how much Maſſachuſetts money comes it to, the exchange at £$81\frac{1}{4}$ Iriſh per £100 Maſſachuſetts?

	£.		£.		£.		£.
As	$81\frac{1}{4}$	:	100	::	673 12/6	:	829 1/$6\frac{6}{13}$

The value of any quantity of ſilver in any of the currencies of the United States, may be found by the following Proportion.

As the number of grains contained in £1 is to £1; ſo are the grains, in any given quantity, to its value.

53. What is the value of 1 lb. of ſilver in Maſſachuſetts currency; the pound (or 20 ſhillings) containing $1393\frac{1}{2}$ grains?

As $1393\frac{1}{2}$: 1 :: 5760 : 4 2/8.

RULE OF THREE DIRECT, IN VULGAR FRACTIONS.

Rule.* Having made the neceſſary preparations, as directed in multiplication and diviſion of vulgar fractions, ſtate your queſtion as in whole numbers, and invert the firſt term of the proportion; then multiply the three terms continually together, and the product will be the anſwer.

---

* This Rule and the next depend upon the ſame principle as the Rule of Three in whole numbers.

1. If $\frac{5}{8}$ of a yard coſt $\frac{5}{7}$ of a £. what will $\frac{9}{15}$ of an ell Engliſh coſt ?

$\frac{5}{8}$ yd. $=\frac{5}{8}$ of $\frac{4}{1}$ of $\frac{1}{5}=\frac{5\times4\times1}{8\times1\times5}=\frac{1}{2}$ ell Engliſh.

E. Eng. £. E. Eng.
As $\frac{1}{2} : \frac{5}{7} :: \frac{9}{15}$ And $\frac{2}{1}\times\frac{5}{7}\times\frac{9}{15}=\frac{2\times5\times9}{1\times7\times15}=\frac{90}{105}$

(= 17s. 1$\frac{1}{2}$d. $\frac{6}{7}$ *Anſ.*

2. If $\frac{3}{5}$ yd. coſt £$\frac{7}{8}$, what will 40$\frac{1}{2}$ yds. come to ?
Anſ. £59 1s. 3d.

3. If 70 buſhels of corn coſt £12$\frac{3}{5}$; what is it per buſhel ?
Anſ. 3s. 7$\frac{1}{5}$d.

4. If $\frac{7}{16}$ of a ſhip coſt £51 ; what are $\frac{3}{32}$ of her worth ?
Anſ. £10 18s. 6$\frac{3}{4}$d. $\frac{3}{7}$

5. At £3$\frac{5}{8}$ per Cwt. what will 9$\frac{2}{3}$lb. come to ?
Anſ. 6s. 3d. $\frac{5}{36}$.

6. A perſon having $\frac{4}{5}$ of a veſſel, ſells $\frac{2}{3}$ of his ſhare for £319 ; what is the whole veſſel worth ?
Anſ. £598 2s. 6d.

7. A merchant ſold 5$\frac{1}{2}$ pieces of cloth, each containing 12$\frac{2}{3}$ yds. at 9s. $\frac{1}{2}$d. per yard ; what did the whole amount to ?
Anſ. £31 9s. 10$\frac{3}{4}$d. $\frac{1}{3}$.

8. A buys of B £560$\frac{3}{4}$ bank ſtock, at £85$\frac{2}{3}$ per cent. what comes it to ?
Anſ. £480 7s. 6$\frac{1}{5}$d.

9. A merchant makes inſurance upon a veſſel and cargo, valued at £3750 16s. at 15$\frac{1}{2}$ guineas per cent. what does the premium amount to ?
Anſ. £813 18s. 5$\frac{1}{2}$d.

10. A merchant in Holland draws a bill upon his correſpondent in Boſton for 3750 Ducats at 8s. 4$\frac{1}{5}$d. how much Maſſachuſetts currency muſt he receive ?
Anſ. £1565 12s. 6d.

11. A gentleman from Boſton being in England, where the price of ſilver is to that of gold, as 1 to 15$\frac{7}{14}$, exchanged 158$\frac{1}{4}$lb. of ſilver for gold ; on his return to Maſſachuſetts, where the price of ſilver is to that of gold, as 1 to 15$\frac{1}{31}$; a friend, wanting his gold, gave him the value thereof in ſilver ; what weight of ſilver did he gain by the exchange ?

As

lb. Sil. G. lb. Sil lb. Gold. G. Sil. G. lb. Sil.
As $15\frac{1}{14} : \frac{1}{1} :: 158\frac{1}{4} : 20\frac{1}{2}$ As $\frac{1}{1} : 15\frac{15}{31} :: 10\frac{1}{2} : 162\frac{36}{62}$.
(*Anſ.* $4\frac{41}{124}$ lb.

12. A merchant bought a number of bales of velvet, each containing $129\frac{17}{27}$ yards, at the rate of 7 dollars for 5 yards, and ſold them out at the rate of eleven dollars for ſeven yards; and gained 200 dollars by the bargain; how many bales were there?

Yds. Dol. Yds. Dol.
As $7 : 11 :: 5 : 7\frac{6}{7}$

Sold 5 yards for $7\frac{6}{7}$ Dollars.
Bought 5 yds. for 7 Dollars.
In 5 yards gain'd $\frac{6}{7}$ Dollar.

D. Yds. D. Yds. Yds. B. Yds. Bales.
As $\frac{6}{7} : 5 :: 200 : 1166\frac{2}{3}$. As $129\frac{17}{27} : \frac{1}{1} :: 1166\frac{2}{3} : 9$ *A.*

Although the method before laid down be univerſally applicable, yet there are other methods more ready and expeditious in ſome particular caſes.

RULE 1. If the firſt and third terms be fractions, and the ſecond a whole number, reduce the firſt and third to one common denominator; then, rejecting the denominators, make the numerator of the firſt, the firſt term, and the numerator of the third, the third term, and work as in whole numbers.

If $\frac{5}{8}$ yard coſt 9s. what coſt $\frac{7}{12}$ yard at that rate?
$\frac{5}{8}=\frac{15}{24}$ & $\frac{7}{12}=\frac{14}{24}$. Now, As 15 : 9s. :: 14 : 8s. $4\frac{3}{4}$d. *A.*

RULE 2. If, of the firſt and third terms, one be 1, and the other a fraction; put the denominator of the fraction inſtead of 1, and the numerator in the place of the fraction, and work as in whole numbers, as before.

If 1 acre of land coſt £12; what will $\frac{5}{8}$ of an acre coſt, at that rate?

Den. £. Num. £. s.
As 8 : 12 :: 5 : 7 10 *Anſ.*

RULE 3. If the ſecond term be a fraction likewiſe, (that is, if all the terms be fractions;) having reduced the firſt and third to one common denominator, multiply the numerator of the firſt term by the denominator of the ſecond, for a diviſor;—and the numerator of the third by the numerator of the ſecond, for a dividend; divide the laſt product by the firſt, and the quotient will be the anſwer.

If $\frac{1}{2}$ yard of cloth coſt £$\frac{3}{4}$ what coſt $\frac{7}{8}$ yard?
$\frac{1}{2}=\frac{4}{8}$, which reduces it to a common denominator, then,

$$\begin{array}{lcl}
\text{As } 4 : \frac{3}{4} :: & 7 & \\
\phantom{\text{As }}4 & 3 & \\
\hline
\phantom{\text{As }}16 & 16)21(1\frac{5}{16}=26\text{s. } 3\text{d. } \textit{Anſ.} & \\
 & 16 & \\
\hline
 & 5 &
\end{array}$$

Problem 1. *To find the value of Gold in Maſſachuſetts currency.*

$$\begin{array}{lcccccccc}
 & \text{oz.} & \text{£.} & \text{oz.} & \text{£.} & \text{pwt.} & \text{s.} & \text{gr.} & \text{d.} \\
\text{Theorem 1. As} & 1 : & 5\frac{1}{3} :: & 12 : & 64 :: & 1 : & 5\frac{1}{3} :: & 1 : & 2\frac{2}{3}
\end{array}$$

(Caſe 1.)$=\frac{2\frac{2}{3}}{1}$ (Caſe 2.)$=\frac{5\frac{1}{3}}{2}$ (Caſe 3.)$=\frac{8}{3}$; therefore,

Rule 1. *If the given quantity be in grains;* multiply them by $2\frac{2}{3}$, and the product is pence.

1. What is the value of 18 grains of gold?

$18 \times 2\frac{2}{3}=48\text{d.}=4\text{s.}$

Rule 2. *If the given quantity conſiſts of ounces, pennyweights and grains,* halve the grains, and then proceed as in multiplication of pounds, ſhillings and pence, making the numerator in Caſe 2, the multiplier.

1. What is the value of 7 oz. 8 pwt. 16 gr. of gold?

$$\begin{array}{lrrr}
\text{gr.} \quad \text{gr.} & \text{oz.} & \text{pwt.} & \text{gr.} \\
16 \div 2 = 8\text{, then} & 7 & 8 & 8 \\
 & & & 5 \\
\hline
 & 37 & 3 & 4 \\
 & 2 & 9 & 6\frac{2}{3} \\
\hline
 & £39 & 12 & 10\frac{2}{3}\ \textit{Anſ.}
\end{array}$$

Rule 3. *If the given quantity conſiſts of pounds only;* multiply by 64, and the product will be the anſwer; but

if

if it conſiſts of pounds, ounces, &c. it will be moſt convenient to reduce the pounds to ounces, and proceed by Rule 2.

What is the value of 36lb. of gold, at £64 per lb.?

36 × 64 = £2304 *Anſ.*

PROB. 2. *To aſcertain the value of any given quantity of gold in Spaniſh milled Dollars.*

THEOREM 2. 1 pwt. of gold $= 5\frac{1}{3}$s. 1 dol. $=$ 6s.

And $\frac{5\frac{1}{3}}{6} = \frac{16}{18} = \frac{8}{9}$, therefore,

RULE. Reduce the given quantity of gold to pennyweights; then, as the denominator is to the given quantity, ſo is the numerator to the anſwer in dollars.

Or,

Divide by the denominator, and multiply the quotient by the numerator.

Or,

Divide by the denominator, and ſubtract the quotient from the dividend; in either caſe you will have the anſwer.

1. What is the value of 6oz. 6pwt. of gold, in Spaniſh dollars?

6oz. 6pwt.
20
126 pwt.

pwt.
As 9 : 126 :: 8
8
9)1008
Anſ. 112 dollars.

Or,
9)126
14 × 8 = 112 *Anſ.*

Or,
9)126
Subt. 14
112 *Anſ.*

PROB. 3. *To aſcertain the weight of gold equivalent to any given ſum, currency.*

RULE 1. *If the given ſum be in pence, reverſe* Rule 1, Theor. 1, *that is*; as the numerator 8 is to the given ſum in pence; ſo is the denominator 3 to the weight required in grains.

What weight of gold is equal to 4s.?

```
          d.               12
As 8 : 48 :: 3             —
           3               48d.
        ———
      8)144
        ———
  Anſ. 18 grains.
```

Rule 2. *If the given ſum be in pounds, ſhillings and pence;* as $5\frac{1}{3}$ is equal to $\frac{16}{3}$; therefore divide the given ſum by 8, and that quotient by 2; add the two quotients together, double the laſt denomination, and you will have the anſwer.

What quantity of gold is equivalent to £45 13s. 4d.?

```
                                    oz.  pwt.  gr.
Mark the pounds, ſhillings }      8)45   13    4
and pence, as oz. pwt. & gr. }      ——————————
                                  2)5    14    2 }
                                    2    17    1 } Add.
                                    ——————————
                                    8    11    3+3
                                    ——————————
                                oz. 8    11    6 Anſ.
```

Prob. 4. *To find the weight of gold equivalent to any given number of dollars.*

Rule. Divide the dollars by the numerator 8, add the quotient to the dividend, and the ſum is pennyweights.

Required the weight of gold equal to 76 dollars?

$76 \div 8 = 9\frac{1}{2}$ and $76 + 9\frac{1}{2} = 85\frac{1}{2}$ pwt. *Anſ.*

RULE OF THREE DIRECT, IN DECIMALS.

Rule. Having reduced your fractions to decimals, and ſtated your queſtion as in whole numbers, multiply the ſecond and third together; divide by the firſt, and the quotient will be the anſwer.

1. If $\frac{5}{8}$ of a yard coſt $\frac{7}{12}$ of a pound; what will $9\frac{2}{3}$ yards come to?

$\frac{5}{8}$=,625, $\frac{7}{12}$=,583+ and $\frac{2}{3}$=,666+

Yd. £. Yd.
As ,625 : ,583 :: 9,666
,583

28998
77328
48330

,625)5,635278(9,0164+=£9 0s. $3\frac{3}{4}$d. *Anſ.*

2. If 1 oz. of ſilver coſt 6s. 8d. what is the price of a bowl, which weighs 1lb. 7oz. 13gr.?

Anſ. £6 6s. 10d.

3. If $9\frac{3}{4}$ yards coſt £3 7s. 6d. what will $\frac{1}{2}$ yard come to?

Anſ. 3s. $5\frac{1}{2}$d.

4. There is a ciſtern which has three cocks, the firſt will empty it in $\frac{1}{4}$ of an hour, the ſecond in $\frac{3}{4}$, and the third in $1\frac{1}{2}$ hour; in what time will it be emptied, if all three run together?

$$\begin{array}{l} \\ \text{As}\left\{\begin{array}{l} \\ \\ \\ \end{array}\right. \end{array}\begin{array}{ccccccc} \text{h.} & & \text{Ciſt.} & & \text{h.} & & \text{Ciſt.} \\ ,25 & : & 1 & :: & 1 & : & 4 \\ ,75 & : & 1 & :: & 1 & : & 1,333+ \\ 1,5 & : & 1 & :: & 1 & : & 0,666+ \\ \hline & & & & & & 6 \text{ ciſtern.} \end{array}$$

Ciſt. h. Ciſt.
As 6 : 1 :: 1 : ,1666+=
[10 min. *Anſ.*

5. A conduit has a cock, which, running into a ciſtern, will fill it in 12 minutes: This ciſtern has 3 cocks; the firſt will empty it in $1\frac{1}{4}$ hour, the ſecond in $37\frac{1}{2}$ minutes, and the third in $\frac{1}{2}$ an hour; in what time will the ciſtern be filled, if all four run together?

$$\text{As}\left\{\begin{array}{ccccccc} \text{h.} & & \text{Ciſt.} & & \text{h.} & & \text{Ciſt.} \\ ,2 & : & 1 & :: & 1 & : & 5 \text{ the filling cock.} \\ 1,25 & : & 1 & :: & 1 & : & 0,8 \\ ,625 & : & 1 & :: & 1 & : & 1,6 \\ ,5 & : & 1 & :: & 1 & : & 2 \\ & & & & & & \overline{4,4} \end{array}\right. \begin{array}{l} \\ \\ \left.\begin{array}{l} \\ \\ \\ \end{array}\right\}\text{emptying do.} \end{array} \left\}\begin{array}{ll} 5 & \text{Ciſt. filled in an hour.} \\ \underline{4,4} & \text{do. emptied in do.} \\ ,6 & \text{ciſtern difference.} \end{array}\right.$$

Then

Ciſt. h. Ciſt. h. h. m.
Then, as ,6 : 1 :: 1 : 1,66+ =1 40 *Anſ.*

The following queſtions are in the Coin of the United States.

6. If 19 yards coſt 25dol. 7d. 5c.; what will $435\frac{1}{2}$ yards come to?

Yds. dol. d. c. Yds.
As 19 : 25 ,7 5 :: 435,5
25,75

21775
30485
21775
8710

D. d. c. m.
19)11214,125(590,2 1 $7\frac{2}{19}$ *Anſ.*

7. If 345 yards of tape coſt 5 dol. 1d. 7c. 5m.; what will one yard coſt?

Yds. D. d. c. m. Yd.
As 345 : 5, 1 7 5 :: 1
1

d. c. m.
345)5, 1 7 5(,0 1 5
3 4 5

1 7 2 5
1 7 2 5

8. If I give 12 dol. 8d. 2c. 5m. for 675 tops; how many tops will 19 mills buy?

D. d. c. m. T. d. c. m.
As 12, 8 2 5 : 675 :: ,0 1 9
,019

6075
675

12,825)12,825(1 top, *Anſwer.*
12,825

RECIPROCAL PROPORTION,

OR,

RULE OF THREE INVERSE,

Teaches, by having three numbers given, to find a fourth, which ſhall have the ſame proportion to the ſecond, as the firſt has to the third.

Therefore, the greater the third term is, in reſpect to the firſt, the leſs will the fourth term be in reſpect to the ſecond; or, the leſs the third term is in proportion to the firſt, the greater the fourth muſt be in proportion to the ſecond; and this is called *reciprocal, inverted* or *indirect* Proportion.

The principal difficulty, that will embarraſs the learner, will be, to diſtinguiſh when the proportion is direct, and when indirect.—This is done by an attentive conſideration of the ſenſe and tenor of the queſtion propoſed: For if thereby it appears, that when the third term of the ſtating is leſs than the firſt, the anſwer muſt be leſs than the ſecond; or when the third is greater than the firſt, the anſwer muſt be greater than the ſecond; then the proportion is direct: But, if the third be leſs than the firſt, and yet the ſenſe of the queſtion requires the fourth to be greater than the ſecond; or if the third being greater than the firſt, the anſwer muſt be leſs than the ſecond, the proportion is inverſe.

Rule. *State and reduce the terms as in the Rule of Three Direct; then, multiply the firſt and ſecond terms together, and divide the product by the third; the quotient will be the anſwer, in the ſame denomination as the middle term was reduced into.

---

* If 4 men can do a piece of work in 12 days; in what time will 8 men do it?

As 4 men : 12 days :: 8 men : $\frac{4 \times 12}{8}$=6 days the anſwer.

And here the product of the firſt and ſecond terms, that is 4 times 12, or 48, is evidently the time in which one man would perform the work; therefore, 8 men will do it in one eighth part of the time, or 6 days.

If there be fractions in your queſtion, they muſt be ſtated as before directed; and if they be vulgar, invert the third term: Then multiply the three terms continually together, and the product will be the anſwer.

EXAMPLES.

1. How much ſhalloon, that is $\frac{3}{4}$ yard wide, will line $6\frac{3}{4}$ yards of cloth, which is $1\frac{1}{4}$ yard wide?

Yd. yds. qr.
As $1\frac{1}{4} : 6\frac{3}{4} :: 3$
4 4
5 27

qrs. qrs. qrs.
As $5 : 27 :: 3$
5
3)135
4)45
$11\frac{1}{4}$ yds. *Anſ.*

The ſame by Vulgar Fractions.

Firſt. $1\frac{1}{4}=\frac{5}{4}$, $6\frac{3}{4}=\frac{27}{4}$, and 3qrs.$=\frac{3}{4}$, then
yds. yds. yd.
As $\frac{5}{4} : \frac{27}{4} :: \frac{3}{4}$ And $\frac{5}{4}\times\frac{27}{4}\times\frac{4}{3}=\frac{5\times27\times4}{4\times4\times3}=\frac{540}{48}=\frac{45}{4}=11\frac{1}{4}$ yds. *Anſ.*

The ſame by Decimal Fractions.

$1\frac{1}{4}=1{,}25$, $6\frac{3}{4}=6{,}75$, and 3qrs.$=,75$, then
yd. yds. yd.
As 1,25 : 6,75 :: ,75
1,25
3375
1350
675
,75)8,4375(11,25 yds. *Anſ.*

2. What length of board $7\frac{1}{2}$ inches wide, will make a ſquare foot?

In. br. In. len. In. br. In. len.
As $12 : 12 :: 7\frac{1}{2} : 19\frac{1}{5}$ *Anſ.*

3. How many yards of carpet, $2\frac{3}{4}$ feet wide, will cover a floor, which is 18 feet long, and 16 feet wide?

ft. ft. ft. ft. yds.
As 16 : 18 :: $\overline{2\frac{3}{4}\times 3}$: $34\frac{10}{11}$ *Anſ.*

Note, I multiply $2\frac{3}{4}$ by 3, becauſe 3 feet=1 yd.

4. Suppoſe I lend a friend £350 for 5 months, he promiſing the like kindneſs; but, when requeſted, can ſpare but £125; how long may I keep it to balance the favour?

£. Mo. £. Mo.
As 350 : 5 :: 125 : 14 *Anſ.*

5. Suppoſe 450 men are in a garriſon, and their proviſions are calculated to laſt but 5 months; how many muſt leave the garriſon, that the ſame proviſions may be ſufficient for thoſe who remain, 9 months?

Mo. Men. Mo. Men. Men.
As 5 : 450 :: 9 : 250, & 450—250=200 Men, *Anſ.*

6. If a man performs a journey in 15 days, when the day is 12 hours long; in how many will he do it, when the day is but 10 hours?

h. d. h. d.
As 12 : 15 :: 10 : 18 *Anſwer.*

7. If a piece of land, 40 rods in length, and 4 in breadth, make an acre; how wide muſt it be, when it is but 19 rods long, to make an acre?

Leng. Br. Leng. Br. ft. in.
As 40 : 4 :: 19 : 8 6 $11\frac{7}{19}$ *Anſ.*

8. If, when wheat is 6s. per buſhel, the two-penny loaf weighs 9,6oz. what ought it to weigh, when wheat is 7s. 6d. per buſhel?

s. oz. s. d. oz. pwt. gr.
As 6 : 9,6 :: 7 6 : 7 13 14.4 *Anſwer.*

9. If a piece of board be 30 inches in length; what breadth will make $1\frac{1}{2}$ ſquare foot?

ſq. f. in. in. in.
As 1,5 : 1 :: 30 : 7,2 *Anſwer.*

10. If 9 men can build a houſe in 5 months, by working 14 hours per day; in what time will the ſame number of men do it, when they work only 10 hours per day?

h. mo. h. mo.
As 14 : 5 :: 10 : 7 *Anſwer.*

11. A wall which was to be built 24 feet high, was raiſed 8 feet by 6 men, in 12 days; how many men muſt be employed to finiſh the wall in 4 days?

ft. men. ft. men.
As 8 : 6 :: $\overline{24-8}$: 12 to finiſh it in 12 days. And

days. men. days. men.
As 12 : 12 :: 4 : 36 to finiſh it in 4 days.

12. There is a ciſtern having a pipe, which will empty it in 6 hours; how many pipes, of the ſame capacity, will empty it in 20 minutes?

ho. pi. min. pi.
As 6 : 1 :: 20 : 18 *Anſwer.*

13. What number of men muſt be employed, to finiſh in 9 days, what 15 men would be 30 days about?

da. men. da. men.
As 30 : 15 :: 9 : 50 *Anſwer.*

14. If a field will feed 6 cows 91 days; how long will it feed 21 cows?

cows. d. cows. d.
As 6 : 91 :: 21 : 26 *Anſwer.*

15. How much in length, that is $8\frac{5}{7}$ inches broad, will make a foot ſquare?

in. in. in. in.
As $\frac{144}{1}$: $\frac{1}{1}$ :: $8\frac{5}{7}$: $16\frac{32}{61}$ *Anſwer.*

16. How much in length, that is $13\frac{7}{8}$ poles in breadth, will make a ſquare acre?

po. po. po. po.
As $\frac{160}{1}$: $\frac{1}{1}$ :: $13\frac{7}{8}$: $11\frac{59}{111}$ *Anſwer.*

17. A regiment of ſoldiers, conſiſting of 745 men, is to be clothed, each ſuit to contain $3\frac{1}{2}$ yards of cloth, which is $1\frac{3}{8}$ yard wide, and lined with ſhalloon $\frac{7}{8}$ yard wide; how many yards of ſhalloon will line them?

As $745 \times 3\frac{1}{2} : 1\frac{3}{8} :: \frac{7}{8} : 4097\frac{1}{2}$ yds. *Anſ.*

18. If a ſuit of clothes can be made of $4\frac{1}{8}$ yards of cloth, $1\frac{3}{8}$ yard wide; how many yards of coating, $\frac{7}{8}$ of a yard wide, will it require for the ſame perſon?

yd. yds. yd. yds. qr. n.
As $1\frac{3}{8} : 4\frac{1}{8} :: \frac{7}{8} : 6$ 1 $3\frac{5}{7}$ *Anſwer.*

ABBREVIATIONS.

To know whether a fraction, when abbreviated, be equivalent in all reſpects to the original given fraction.

Rule. As the numerator of the fraction, in its loweſt terms, is to its denominator; ſo will the numerator of the original fraction be to its own denominator.

Or, as one numerator is to the other; ſo will one denominator be to the other, &c.

A owes B £75 13s. 6d. now £100 of A's money is equal to £140 of B's; what muſt A pay to ſatisfy the ſaid debt?

£. s. d.
$\frac{100}{140}=\frac{5}{7}$ therefore, 75 13 6
5

7)378 7 6

£54 1 $0\frac{6}{7}$ *Anſ.*

Now, to prove whether $\frac{5}{7}$ be equal to $\frac{100}{140}$.

Num. Den. Num. Den. Num. Num. Den. Den.
As 5 : 7 :: 100 : 140—Or, as 5 : 100 :: 7 : 140.

COMPOUND PROPORTION,

OR,

DOUBLE RULE OF THREE,

Teaches to reſolve ſuch queſtions as require two, or more ſtatings, by ſimple proportion; and that, whether direct, or inverſe :—It is compoſed (commonly) of 5 numbers to find a ſixth, which, if the proportion be direct, muſt bear ſuch proportion to the 4th and 5th, as the 3d bears to the 1ſt and 2d: But if inverſe, the 6th number muſt bear ſuch proportion to the 4th and 5th, as the 1ſt bears to the 2d and 3d.

Always place the three conditional terms in this order: That number, which is the principal cauſe of gain, loſs or action, poſſeſſes the firſt place; that which denotes the ſpace of time or diſtance of place, the ſecond; and that, which is the gain, loſs or action, the third; this being done, place the other two terms, which move the queſtion, under thoſe of the ſame name, and if the blank place, or term ſought, fall under the third place, then the queſtion is in direct proportion; therefore,

Rule 1. Multiply the three laſt terms together, for a dividend, and the two firſt for a diviſor :—— But if the blank fall under the firſt or ſecond place; then, the proportion is inverſe; therefore,

Rule 2. Multiply the firſt, ſecond and laſt terms together for a dividend, and the other two for a diviſor, and the quotient will be the anſwer.

1. If £100 gain £6 in a year; what will £400 gain in 9 months?

£. P. Mo. £. Int.
100 : 12 :: 6 Terms in the ſuppoſition, or conditional terms.
400 : 9 Terms which move the queſtion.

Here, the blank falling under the third place, the queſtion is in direct proportion, and the anſwer muſt be found by the firſt rule; therefore,

400

```
400×9×6=21600 For the dividend, and
100×12  = 1200 For the diviſor.
```

See the work at large.

```
        £.Pr.  Mo.  £.Int.
         100 : 12 :: 6
         400 :  9
           9                  12,00)216,00(18£. Anſwer.
         ----                        12
   100   3600                        --
    12      6                        96
   ---------                         96
12,00)216,00(                        --
```

2. If £100 will gain £6 in a year; in what time will £400 gain £18?

```
100 : 12 ::  6   Terms in the ſuppoſition.
400 :    :: 18   Terms which move the queſtion.
```

Here, the blank falling under the 2d place, the queſtion is in reciprocal or inverſe Proportion, and the anſwer muſt be ſought by the ſecond Rule: Therefore,

```
100×12×18=21600 For the dividend.
400×6    = 2400 For the diviſor.
      £.Pr.   mo.  £.Int.
       100 :  12 ::  6
       400 :     :: 18
         6           12
      ----          ---
      2400          216
                    100
                   ----
           24|00)216|00(9 months, Anſwer.
                 216
```

3. If £400 gain £18 in 9 months; what is the rate per cent. per annum?

Pr. mo. Int.
400 : 9 :: 18
100 : 12
18
96
12
400 216
9 100
36|00) 216|00(£6 *Anſwer.*
216

4. What principal, at 6 per cent. per ann. will gain £18 in 9 months?

Pr. mo. Int.
100 : 12 :: 6
9 :: 18
12
9 216
6 100
£.
54)21600(400 *Anſwer.*
216
00

5. If 8 men ſpend £32 in 13 weeks; what will 24 men ſpend in 52 weeks?

M. W. £.
8 : 13 :: 32
24 : 52 £384 *Anſwer.*

6. If the freight of 9 hhds. of ſugar, each weighing 12 Cwt. 20 leagues, coſt £16; what muſt be paid for the freight of 50 tierces ditto, each weighing 2$\frac{1}{2}$ Cwt. 100 leagues?

hhds. leag. £.
9 : 20 :: 16
50 : 100 £92 11 10$\frac{2}{9}$ *Anſ.*

P

7. There was a certain edifice completed in a year by 20 workmen; but the ſame being demoliſhed, it is neceſſary that juſt ſuch another ſhould be built in 5 months; I demand the number of men to be employed about it?

Men. mo. Ed.
20 : 12 :: 1
5 :: 1 48 men, *Anſ.*

8. If 6 men build a wall 20 feet long, 6 feet high and 4 feet thick, in 16 days; in what time will 24 men build one 200 feet long, 8 feet high, and 6 feet thick?

Men. da. ft.
6 : 16 :: $\overline{20\times6\times4}$
24 : :: $\overline{200\times8\times6}$ 80 days, *Anſ.*

COMPARISON OF WEIGHTS AND MEASURES.

EXAMPLES.

1. If 78 pence Maſſachuſetts be worth 1 French crown; how many Maſſachuſetts pence are worth 320 French crowns?

Fr.Cr. d. Fr.Cr.
As 1 : 78 :: 320 : 24960d. *Anſ.*

2. If 24 yards at Boſton make 16 ells at Paris, how many ells at Paris will make 128 yards at Boſton?

Boſt. Par. Boſt. Par.
As 24yds. : 16ells. :: 128yds. : 85$\frac{1}{3}$ells, *Anſ.*

3. If 60lb. at Boſton make 56lb. at Amſterdam; how many lb. at Boſton will be equal to 350 at Amſterdam?

Amſ. Boſt. Amſ. Boſt.
lb. lb. lb. lb.
As 56 : 60 :: 350 : 375 *Anſ.*

CONJOINED PROPORTION

Is when the coins, weights or meaſures of ſeveral countries are compared in the ſame queſtion; or, in other words, it is joining many proportions together, and by the relation, which ſeveral antecedents have to their conſequents, the proportion between the firſt antecedent and the laſt conſequent is diſcovered, as well as the proportion between the others in their ſeveral reſpects.

This Rule may generally be ſo abridged by cancelling equal quantities on both ſides, and abbreviating commenſurables, that the whole operation may be performed with very little trouble—and it may be proved by as many ſtatings in the Single Rule of Three as the nature of the queſtion may require.

CASE I.

When it is required to find how many of the firſt ſort of coin, weight, or meaſure, mentioned in the queſtion, are equal to a given quantity of the laſt.

Rule. Place the numbers alternately, that is, the antecedents at the left hand, and the conſequents at the right, and let the laſt number ſtand on the left hand; then multiply the left hand column continually for a dividend, and the right hand for a diviſor, and the quotient will be the anſwer.

EXAMPLES.

1. Suppoſe 100 yards of America=100 yards of England, and 100 yards of England=50 canes of Thoulouſe, and 100 canes of Thoulouſe=160 ells of Geneva, and 100 ells of Geneva=200 ells of Hamburgh; how many yards of America are equal to 379 ells of Hamburgh?

Antecedents.

Antecedents.	Conſequents.	Abridged.	
		Ant.	Con.
100 of America=	100 of England.		
100 of England=	50 of Thoulouſe.	5	8
100 of Thoulouſe=	160 of Geneva.	379	
100 of Geneva=	200 of Hamburgh.		
379 of Hamburgh ?			

Therefore,

$\frac{379\times 5}{8}=236\frac{7}{8}$yds. of America=379ells of Hamburgh.

ILLUSTRATION.

The two 100's on both ſides cancel each other: Let the laſt cyphers of the three next antecedents and conſequents be cancelled, which is dividing by 10; then divide the ſecond antecedent and conſequent by 5, and the quotients will be 2 on the ſide of the antecedents, and 1 on the ſide of the conſequents; then 2 will meaſure the third antecedent and conſequent, and the quotients will be 5 and 8.—10 will meaſure the 4th antecedent and conſequent, and the quotients will be 1 and 2: Now, there being 2 left on each ſide, they cancel each other, and as there is no farther room for abridging, by reaſon of the odd number 379, the operation is finiſhed, and the anſwer found, as above.

2. If 20lb. at Boſton make 23lb. at Antwerp, and 155 at Antwerp make 180 at Leghorn; how many at Boſton are equal to 144 at Leghorn?

Antecedents. Conſequents.
lb. lb.
20 of Boſton = 23 of Antwerp. $20\times 155\times 144=446400$ Div.
155 of Antwerp=180 of Leghorn. $23\times 180=4140$ Diviſor.
144 of Leghorn. 414|0)44640|0(107$\frac{19}{23}$ *Anſ.*

Or, abridged, $\frac{155\times 144}{23\times 9}=107\frac{19}{23}$.

3. If 12lb. at Boſton make 10 at Amſterdam, 100lb. at Amſterdam, 120 at Paris; how many lb. at Boſton are equal to 80lb. at Paris? *Anſ.* 80lb.

4. If 140 braces at Venice be equal to 150 braces at Leghorn, and 7 braces at Leghorn be equal to 4

American yards; how many Venetian braces are equal to 32 American yards? *Anſ.* 52$\frac{4}{15}$.

5. If 40lb. at Newburyport make 36 at Amſterdam, and 90lb. at Amſterdam make 116 at Dantzick; how many lb. at Newburyport are equal to 260lb. at Dantzick? *Anſ.* 224$\frac{4}{29}$.

CASE II.

When it is required to find how many of the laſt ſort of coin, weight or meaſure, mentioned in the queſtion, are equal to a given quantity of the firſt.

Rule. Place the numbers alternately, beginning at the left hand, and let the laſt number ſtand on the right hand; then multiply the firſt row for a diviſor, and the ſecond for a dividend.

EXAMPLES.

1. If 12lb. at Boſton make 10lb. at Amſterdam, and 100lb. at Amſterdam make 120 at Paris; how many at Paris are equal to 80 at Boſton?

	Left.	Right.
Boſton	12	10
Amſterdam	100	120
		80

$$\frac{10\times120\times80=96000}{12\times100=1200}=80 \text{ Anſ.}$$

2. If 40lb. at Newburyport make 36 at Amſterdam, and 90lb. at Amſterdam make 116 at Dantzick; how many lb. at Dantzick are equal to 244 at Newburyport? *Anſ.* 283$\frac{12}{25}$.

ARBITRATION OF EXCHANGES.

By this term is underſtood how to chooſe, or determine the beſt way of remitting money from abroad with advantage; which is performed by conjoined proportion: Thus,

Suppoſe a merchant has effects at Amſterdam to the amount of 3530 dollars, which he can remit by way of Liſbon at 840 rees per dollar, and thence to Boſton, at

8s. 1d. per millree (or 1000 rees :)—*Or*, by way of Nantz, at $5\frac{2}{5}$ livres per dollar, and thence to Boſton at 6s. 8d. per crown : It is required to arbitrate theſe exchanges, that is, to chooſe that which is moſt advantageous ?

1 Dollar at Amſterdam=840 rees at Liſbon.
1000 rees at Liſbon = 97d. at Boſton.
3530 Dollars at Amſterdam.

$\frac{840\times 97\times 3530}{1000\times 1}=$£1198 8s. $8\frac{4}{10}$d. By way of Liſbon.

1 Dollar at Amſt.=$5\frac{2}{5}$ livres at Nantz.
6 Livres at Nantz=80 pence at Boſton.
3530 dollars at Amſterdam.

$\frac{5\frac{2}{5}\times 80\times 3530}{1\times 6}=$£1059 By way of Nantz.

Here it may be obſerved, that the difference is £139 8s. $8\frac{4}{10}$d. in favour of remitting by way of Liſbon rather than by Nantz, which depends on the courſe of exchange, at that time ; but the courſe may vary ſo, that in a ſhort time, by way of Nantz may be better ; hence appears the neceſſity and advantage of an extenſive correſpondence, to acquire a thorough knowledge in the courſes of exchange, to make this kind of remittance.

FELLOWSHIP.

The Rules of Fellowſhip are thoſe by which the accounts of ſeveral merchants, or other perſons, trading in partnerſhip, are ſo adjuſted, that each may have his ſhare of the gain, or ſuſtain his ſhare of the loſs, in proportion to his ſhare of the joint ſtock, together with the time of its continuance in trade.

SINGLE FELLOWSHIP

Is, when the ſtocks are employed for any certain equal time.

Rule.[*] As the whole ſtock is to the whole gain or loſs; ſo is each man's particular ſtock, to his particular ſhare of the gain or loſs.

Proof. Add all the particular ſhares of the gain or loſs together, and, if it be right, the ſum will be equal to the whole gain or loſs.

EXAMPLES.

1. Divide the number 360 into 4 ſuch parts, which ſhall be to each other as 3, 4, 5, & 6.

$$\text{As } 3+4+5+6 : 360 :: \left\{\begin{array}{l} 3 : 60 \\ 4 : 80 \\ 5 : 100 \\ 6 : \underline{120} \end{array}\right\} \textit{Anſwer.}$$

$$\qquad\qquad 360 \ \textit{Proof.}$$

2. A, B, C and D companied;—A put in £145; B 219; C 378, and D 417, with which they gained £569; what was the ſhare of each?

$$\begin{array}{cc} \textit{Whole Stock.} & \textit{Gain.} \\ \text{As } 145+219+378+417 : & 569 :: \end{array} \left\{\begin{array}{lrrll} & \text{£.} & \text{s.} & \text{d.} & \text{ſhare.} \\ 145 : & 71 & 3 & 8\frac{1}{2} & \frac{1058}{1159} \text{ A's} \\ 219 : & 107 & 10 & 3\frac{3}{4} & \frac{375}{1159} \text{ B's} \\ 378 : & 185 & 11 & 6 & \frac{552}{1159} \text{ C's} \\ 417 : & 204 & 14 & 5\frac{1}{4} & \frac{333}{1159} \text{ D's} \end{array}\right.$$

$$\text{£}569 \text{ — — —} \textit{Proof.}$$

3. A, B, C and D are concerned in a joint ſtock, of £168 2s. 6d.; of which A's part is £25 10s. B's £37 15s. C's £49, and D's £55 17s. 6d.: Upon the adjuſtment of their accounts, they have loſt £73 13s. 4d.: What is the loſs of each?

Anſ. A's loſs £11 3s. 5½d. B's £16 10s. 9¾d. C's £21 9s. 4¾d. and D's £24 9s. 7¾d.

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[*] That their gain or loſs, in this rule, is in proportion to their ſtock, is evident: For, as the times, in which the ſtocks are in trade, are equal, if I put in ½ the whole ſtock, I ought to have ½ of the gain.

4. A and B companied: A put in £45, and took $\frac{3}{5}$ of the gain: What did B put in?

5—3=2. Then, as 3 : 45 :: 2 : 30 *Anſ.*

5. A, B and C freighted a ſhip, with 68900 feet of boards: A put in 16520 feet; B 28750; and C the reſt: But, in a ſtorm, the Captain threw overboard 26450 feet: How much muſt each ſuſtain of the loſs?

Anſ. A 6341$\frac{3}{4}$ feet, B 11036$\frac{3}{4}$, and C 9071$\frac{1}{2}$ feet.

6. A gentleman died, leaving three ſons and a daughter; to whom he bequeathed his eſtate in the following manner: To the eldeſt ſon, he gave 312 moidores; to the ſecond, 312 guineas; to the third, 312 piſtoles; and to the daughter, 312 dollars; but when his debts were paid, there were but 312 half joes left: What muſt each have in proportion to the legacies which had been bequeathed them?

Anſ. 1ſt ſon £293 0s. 2d.—2d ſon £227 17s. 10$\frac{3}{4}$d. 3d ſon £179 1s. 2$\frac{1}{2}$d.—and the daughter £48 16s. 8$\frac{1}{4}$d.

7. A ſhip worth £780, being loſt at ſea, of which $\frac{1}{5}$ belonged to A, $\frac{1}{2}$ to B, and the reſt to C; what loſs will each ſuſtain, ſuppoſing £450 to have been inſured upon her?

780—450=330; then $\frac{1}{6}$)330 $\frac{1}{2}$)330 $\frac{1}{3}$)330

£55=A's £165=B's £110 =C's ſhare.

8. A and B venturing equal ſums of money, cleared by joint trade £140: By agreement, as A executed the buſineſs, he was to have 8 per cent. and B was to have 5 per cent.; what was A allowed for his trouble?

£. £. £. £. £. £. £. £. £. £.
As 8+5 : 140 :: 8 : 86$\frac{2}{13}$ & As 8+5 : 140 :: 5 : 53$\frac{11}{13}$

Anſ. £32 6s. 1$\frac{3}{4}$d. $\frac{5}{13}$.

9. A bankrupt is indebted to A £120, to B 230, to C 340, and to D 450, and his whole eſtate amounts only to £560; how muſt it be divided among the creditors?

Anſ. A £58 18s. 11$\frac{1}{4}$d. B. £112 19s. 7$\frac{3}{4}$d. C £167 0s. 4d. D £221 1s. 0$\frac{1}{2}$d.

10. A, B and C put their money into a joint ſtock : A put in £40, B and C together, 170 ; they gained £126, of which B took 42 ; what did A and C gain, and B and C put in reſpectively ?

As 210 the whole ſtock : 126 the whole gain :: 40 A's ſtock : 24 A's gain.

As £24 A's gain : 40 A's ſtock :: 42 B's gain : 70 B's ſtock. Then £170—£70=£100 C's ſtock ; and the whole gain £126—£66 A's and B's gain=£60 C's gain.

11. A, B and C companied : A put in £40 ; B £60, and C a ſum unknown : They gained £72 ; of which C took 32 for his ſhare : What did A and B gain, and C put in ?

The whole gain £72—C's gain £32=40 A's and B's gain : Then, As £100 A's and B's ſtock : £40 their gain :: £40 A's ſtock : £16, his gain. Again, As £16 A's gain : £40, his ſtock :: £32 C's gain : £80 his ſtock.

12. A, B and C put in £720, and gained £540, of which, ſo often as A took up £3, B took up 5, and C 7 ; what did each put in and gain ?

Money taken up.

$$\text{As } 3+5+7+ : 540 :: \left\{\begin{array}{l} 3 : 108 \text{ A's gain.} \\ 5 : 180 \text{ B's ditto.} \\ 7 : 252 \text{ C's ditto.} \end{array}\right.$$

$$\textit{And}\text{, as } 3+5+7 : \overset{\pounds.}{720} :: \left\{\begin{array}{l} 3 : 144 \text{ A's ſtock.} \\ 5 : 240 \text{ B's ditto.} \\ 7 : 336 \text{ C's ditto.} \end{array}\right.$$

Or, you may find a common multiplier to multiply the proportions by, or multiplicand to be multiplied by the given proportions, thus, 15)720(48 multiplicand, to find the ſtocks—and 15)540(36 multiplicand, to find the gains.

$$\left.\begin{array}{l} \qquad\quad \pounds. \\ 48 \times 3 = 144 \text{ A's ſtock.} \\ 48 \times 5 = 240 \text{ B's ditto.} \\ 48 \times 7 = 336 \text{ C's ditto.} \end{array}\right\} \text{and} \left\{\begin{array}{l} \qquad\qquad\quad \pounds. \\ 36 \times 3 = 108 \text{ A's gain.} \\ 36 \times 5 = 180 \text{ B's do.} \\ 36 \times 7 = 252 \text{ C's do.} \end{array}\right.$$

(as before.

13. A, B, C and D companied, and gained a ſum of money; of which, A, B and C took £120, B, C and D, £180, C, D and A, £160, and D, A and B, £140; what diſtinct gain had each?

The ſum of theſe 4 numbers is £600, and as each man's money is named 3 times, therefore $\frac{1}{3}$, viz. £200 is the whole gain—Therefore £200—120 A's, B's and C's gain = 80 D's gain:—And 200—180 B's, C's and D's gain = 20 A's gain. 200—160 C's, D's and A's gain = 40 B's gain. And £200—140 D's, A's and B's gain = 60 C's gain.

14. Two merchants companied: A put in £40, and B 288 ducats: They gained £135, of which A took £60; what was the value of a ducat?

As 60, A's gain : 40, his ſtock :: 135, the whole gain—60 A's gain : 50 B's gain.

$$\begin{array}{lcccccc} & \text{Duc.} & & \text{£.} & & \text{Duc.} & \text{s. d.} \\ \text{And, As} & 288 & : & 50 & :: & 1 & : 3\ 5\tfrac{2}{3}\ \textit{Anſ.} \end{array}$$

15. Four men ſpent at a reckoning, 20 ſhillings; of which they agreed that A ſhould pay $\frac{3}{4}$, B, $\frac{1}{2}$, C, $\frac{1}{4}$, and D, $\frac{1}{8}$; what muſt each pay in that proportion?

$$\begin{array}{l} \textit{Shares to be paid}\ \ \text{s.} \\ \text{As}\ \tfrac{3}{4}+\tfrac{1}{2}+\tfrac{1}{4}+\tfrac{1}{8} : 20 :: \end{array} \left\{\begin{array}{rr} \text{s.} & \text{d.} \\ 15 & \\ 10 & \\ 5 & \\ 2 & 6 \end{array}\right. \begin{array}{c} \\ : \\ : \\ : \\ : \end{array} \left.\begin{array}{rl} \text{s.} & \text{d} \\ 9 & 2\tfrac{10}{13} \\ 6 & 1\tfrac{11}{13} \\ 3 & 0\tfrac{12}{13} \\ 1 & 6\tfrac{6}{13} \end{array}\right\} \textit{Anſ.}$$

DOUBLE FELLOWSHIP,*

Or, *Fellowſhip with Time*, is occaſioned by the ſhares of partners being continued unequal times.

RULE. Multiply each man's ſtock, or ſhare, by the time it was continued in trade: Then,

As the whole ſum of the products, is to the whole gain or loſs:

---

* When the times are equal, the ſhares of the gain or loſs are evidentl[illegible] the ſtocks, as in Single Fellowſhip; and when the ſtocks are equal, the ſhares are as the times; wherefore, when neither are equal, the ſhares muſt be as their product.

So is each man's particular product, to his particular ſhare of the gain or loſs.

1. A, B and C hold a paſture in common, for which they pay £40 per annum. A put in 9 oxen for 5 weeks; B, 12 oxen for 7 weeks, and C, 8 oxen for 16 weeks; what muſt each pay of the rent?

$9 \times 5 = 45$. $12 \times 7 = 84$, and $8 \times 16 = 128$; then $128 + 84 + 45 = 257$,

As 257 : 40 :: 45	As 257 : 40 :: 84	As 257 ; 40 :: 128
45	84	40
——	——	——
200	160	257)5120(19
160	320	257
——	——	——
257)1800(7	257)3360(13	2550
1799	257	2313
——	——	——
1	790	237
20	771	20
——	——	——
257)20(0	19	257)4740(18
12	20	257
——	——	——
257)240(0	257)380(1	2170
4	257	2056
——	——	——
257)960(3	123	114
771	12	12
——	——	——
189	257)1476(5	257)1368(5
	1285	1285
	——	——
	191	83
	4	4
	——	——
	257)764(2	257)332(1
	514	257
	——	——
	250	75

2. Four merchants traded in company; A put in £100, for 5 months; B, 150 for 7 months; C, 220, for 8 months; and D, 310, for 9 months; but by mis-

fortunes at ſea they loſt £145 ; what muſt each man ſuſtain of the loſs ?

Anſ. $\left\{\begin{array}{llll} \text{A, £11} & 17/8\frac{1}{4}\ \frac{51}{61} & \text{C, £41} & 16/8\frac{1}{2}\ \frac{38}{61} \\ \text{B, }\ \ 24 & 19/2\ 0\frac{40}{61} & \text{D, }\ \ 66 & 6/4\frac{1}{2}\ \frac{54}{61} \end{array}\right\}$

3. A, with a capital of £100 began trade, January 1ſt, 1792, and meeting with ſucceſs in his buſineſs, he took in B as a partner, on the firſt day of March following, with a capital of £150. Three months after that, they admit C, as a third partner, who brought into ſtock £180, and after trading together till the 1ſt of January, 1793, they found there had been gained ſince A's commencing buſineſs, £177 13s. How muſt this be divided among the partners ?

Anſ. A, £53 16/8—B, £67 5/10—C, £56 10/6.

4. Two merchants entered into partnerſhip for 18 months ; A, at firſt, put into ſtock, £100, and at the end of 8 months, he put in 50 more ; B, at firſt, put in £275, and at 4 month's end, took out £70. Now, at the expiration of the time, they found they had gained £263 : What is each man's juſt ſhare ?

Anſ. A, £96 9/6. B, £166 10/6.

5. A and B companied ; A put in the 1ſt of January, £150 ; but B could not put in any till the 1ſt of May : What did he then put in, to have an equal ſhare with A, at the year's end ?

$$\begin{array}{lllll} & \text{M.} & \text{£.} & \text{M.} & \\ \text{As } & 12 : & 150 :: & 8 : & \dfrac{150\times12}{8}=\text{£}225\ \textit{Anſ.} \end{array}$$

6. A, B and C companied ; A put in the 1ſt of March, £30 ; B, the 1ſt of May, put in 80 yards of broadcloth ; and on the 1ſt of June, C put in 120 dollars. On the firſt of January following, they reckoned their gains, of which A and B took £228 ; B and C, £215 10s. and C and A, £187 10s. What was the whole gain, and the gain of each ? What did they value a yard of cloth at ? And, what was C's dollar worth ?

228+215 10s.+187 10s.=£631; and 631÷2=315 10s. the whole gain; then, £315 10s.—228=£87 10s. C's gain, £315 10s.—£215 10s.=£100 A's gain, and £315 10s.—£187 10s.=£128 B's gain. To find the value of one yard of cloth; ſay, As £100 A's gain : 30 his ſtock :: 128 B's gain : £38 8s.; then, inverſely, As 10 months : £38 8s. :: 8 months : £48 the value of the whole cloth. As 80 yds. : £48 :: 1 yd. : 12s. anſwer. Now, to find the value of a dollar; As £100 A's gain : 30 his ſtock :: £87 10s. C's gain : £26 5s.; then, inverſely, As 10 months : £26 5s. :: 7 months : £37 10s. =120 dollars. Laſtly, As 120 dollars : £37 10s. :: 1 dollar : 6/3 anſwer.

FELLOWSHIP BY DECIMALS.

Rule. Divide the whole gain, or loſs, by the whole ſtock; and the quotient multiplied ſeverally by each man's ſtock, will give the gain, or loſs, of each.

EXAMPLES.

1. A, B and C companied; A put in £200, B, 150, and C, 50, with which they gained 800; what is the ſhare of each?

Anſ. 800÷400=2; then 200×2=£400=A's gain, 150×2=£300=B's gain, and 50×2=100=C's gain.

2. A, B, C and D trade, and gain £200, which is to be divided in the following manner, viz. So often as A has £6 B muſt have 10, C, 14, and D, 20; what is the ſhare of each?

6+10+14+20=50, and $\frac{200}{50}$=4, quotient; then 6×4=£24 A's gain; 10×4=£40 B's gain; 14×4 =56 C's, and 20×4=£80 D's gain.

3. A, B and C companied; A put in £40 5s. B, £80 10s. and C, £161, with which they gained £120; what is each man's ſhare of the gain?

A's ſtock = 40,25
B's ditto = 80,5
C's ditto = 161

Sum total = 281,75)120,000000(,4259+

,4259	,4259	,4259
40,25	80,5	161
21295	21295	4259
8518	340720	25554
170366	£34,28495	4259
£17,142475	20	£68,5699
20	5,699200	20
2,849500	12	11,3980
12	8,388	12
10,194000	4	4,776
4	1,552	4
0,776000		3,104

Proof. A's gain £17 2s. 10d. + B's gain £34 5s. 3$\frac{1}{4}$d. + C's gain £68 11s. 4$\frac{3}{4}$d. = £119 19s. 11d.

PRACTICE

Is a contraction of the Rule of Three Direct, when the firſt term happens to be a unit, or one; and has its name from its daily uſe among merchants and tradeſmen, being an eaſy and conciſe method of working moſt queſtions which occur in trade and buſineſs.[*]

The method of proof is by the Rule of Three, Compound Multiplication, or by varying the order of them.

Before the queſtions, hereafter given, can be wrought, the following tables muſt be perfectly gotten by heart.

TABLES.

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[*] General Rule.

1. Suppoſe the price of the given quantity to be £1 or 1s. &c. then will the quantity itſelf be the anſwer at the ſuppoſed price.

2. Divide the given price into aliquot parts, either of the ſuppoſed price, or of one another, and the ſum of the quotients belonging to each will be the true anſwer required.

EXAMPLE.

What is the value of 468 yards at 2/9¼ per yard?

	£468	s.	d.	*Anſwer at*	£1	s.	d.
2s. 6d. is $\frac{1}{8}$ =	58	10	—	ditto at	—	2	6
3d. is $\frac{1}{10}$ =	5	17	—	ditto at	—	—	3
$\frac{1}{4}$d. is $\frac{1}{12}$ =	—	9	9	ditto at	—	—	$\frac{1}{4}$
The full price =	£64	16	9		—	2	9¼

In this example, it is plain that the quantity 468 is the anſwer at £1; conſequently, as 2/6 is $\frac{1}{8}$ of a pound, $\frac{1}{8}$ part of that quantity, or £58 10s. is the price at 2/6; in like manner, as 3d. is the $\frac{1}{10}$ part of 2s. 6d. ſo $\frac{1}{10}$ part of £58 10s. or £5 17s. is the anſwer at 3d. and as $\frac{1}{4}$d. is $\frac{1}{12}$ of 3d. ſo $\frac{1}{12}$ of £5 17s. or 9s. 9d. is the anſwer at $\frac{1}{4}$d. Now, as the ſum of all theſe parts is equal to the whole price (2s. 9¼d.) ſo the ſum of the anſwers belonging to each price will be the anſwer at the full price required, and the ſame will be true in any example whatever.

TABLES.

Aliquot, or even parts of Money.

Pts. of a ſhil. or a £.

d.		s.		£.
6	=	$\frac{1}{2}$	=	$\frac{1}{40}$
4	=	$\frac{1}{3}$	=	$\frac{1}{60}$
3	=	$\frac{1}{4}$	=	$\frac{1}{80}$
2	=	$\frac{1}{6}$	=	$\frac{1}{120}$
1½	=	$\frac{1}{8}$	=	$\frac{1}{160}$
1	=	$\frac{1}{12}$	=	$\frac{1}{240}$
¾	=	$\frac{1}{16}$	=	$\frac{1}{320}$
½	=	$\frac{1}{24}$	=	$\frac{1}{480}$
¼	=	$\frac{1}{48}$	=	$\frac{1}{960}$

Parts of a ſhilling.

d.		2s.
1	is	$\frac{1}{24}$
1½	—	$\frac{1}{16}$
2	—	$\frac{1}{12}$
3	—	$\frac{1}{8}$
4	—	$\frac{1}{6}$
6	—	$\frac{3}{4}$
8	—	$\frac{1}{3}$

Pts. of a pound.

s.	d.		£.
10	0	is	$\frac{1}{2}$
6	8	—	$\frac{1}{3}$
5	0	—	$\frac{1}{4}$
4	0	—	$\frac{1}{5}$
3	4	—	$\frac{1}{6}$
2	6	—	$\frac{1}{8}$
1	8	—	$\frac{1}{12}$
1	4	—	$\frac{1}{15}$
1	3	—	$\frac{1}{16}$
1	0	—	$\frac{1}{20}$
0	10	—	$\frac{1}{24}$
0	8	—	$\frac{1}{30}$
0	5	—	$\frac{1}{48}$
0	2½	—	$\frac{1}{96}$

Aliquot, or even parts of Weight.

Parts of a Cwt.

Qrs.	lb.		Cwt
2	0	is	$\frac{1}{2}$
1	0	—	$\frac{1}{4}$
0	16	—	$\frac{1}{6}$
0	14	—	$\frac{1}{7}$
0	8	—	$\frac{1}{14}$
0	7	—	$\frac{1}{16}$
0	4	—	$\frac{1}{28}$

Pts. of ½ Cwt.

lb.		½ Cwt
28	is	$\frac{1}{2}$
14	—	$\frac{1}{4}$
8	—	$\frac{1}{7}$
7	—	$\frac{1}{8}$
4	—	$\frac{1}{14}$

Pts. of ¼ Cwt.

lb.		¼ Cwt.
14	is	$\frac{1}{2}$
7	—	$\frac{1}{4}$
4	—	$\frac{1}{7}$
2	—	$\frac{1}{14}$

Pts. of a Ton.

Cwt.	qr.		T.
10	0	is	$\frac{1}{2}$
5	0	—	$\frac{1}{4}$
4	0	—	$\frac{1}{5}$
2	2	—	$\frac{1}{8}$
2	0	—	$\frac{1}{10}$
1	1	—	$\frac{1}{16}$
1	0	—	$\frac{1}{20}$

Parts of 240.

180	is	$\frac{3}{4}$
120	—	$\frac{1}{2}$
80	—	$\frac{1}{3}$
60	—	$\frac{1}{4}$
40	—	$\frac{1}{6}$

Parts of 480.

360	is	$\frac{3}{4}$
160	—	$\frac{1}{3}$

Another TABLE *of* Aliquot Parts *of* Money.

Parts of a ſhilling.

d.		s.
10	is	$\frac{5}{6}$
9	—	$\frac{3}{4}$
8	—	$\frac{2}{3}$
7½	—	$\frac{5}{8}$
4½	—	$\frac{3}{8}$

Parts of a pound.

s.	d.		£.
18	0	is	$\frac{9}{10}$
17	6	—	$\frac{7}{8}$
16	8	—	$\frac{5}{6}$
16	0	—	$\frac{8}{10}$
15	0	—	$\frac{3}{4}$
14	0	—	$\frac{7}{10}$

Parts of a pound.

s.	d.		£.
13	4	is	$\frac{2}{3}$
12	6	—	$\frac{5}{8}$
12	0	—	$\frac{6}{10}$
8	0	—	$\frac{4}{10}$
7	6	—	$\frac{3}{8}$
6	0	—	$\frac{3}{10}$

A TABLE *of* DISCOUNT *per cent.*

£.		s.	d.	
1¼	per cent. is	0	3	on the pound.
2½		0	6	
3¾		0	9	
5		1	0	
6¼		1	3	
7½		1	6	

£.		s.	d.	
8¾	per cent. is	1	9	on the pound.
10		2	0	
12½		2	6	
15		3	0	
17½		3	6	
20		4	0	

£.		s.	d.	
22½	per cent. is	4	6	on the pound.
25		5	0	
30		6	0	
35		7	0	
40		8	0	
45		9	0	
50		10	0	

CASE I.

When the price of 1 *yard,* 1lb. *&c. is an even part of one ſhilling* ;—Find the value of the given quantity at 1s. per yard, lb. &c: then draw a line underneath, and divide it by *that even part*, and the quotient will be the anſwer in ſhillings; which muſt always be brought into pounds.

EXAMPLES.

1. What will 354½ yards coſt, at ¼d. per yard?

s. d.

|¼d.|$\frac{1}{48}$|354 6 value of 354½ yards, at 1s. per yard.

Anſ. £0 7 4½ value of 354½ yards, at ¼d. per yard.

Or thus, Or divide by 8 and 6, thus; 8)354 6

£. s. d. s. d.

8)17 14 6 = 354 6 6)44 3¾

6)2 4 3¾ *Anſ.* 7 4½ as [before.

7 4½ *Anſ.* as before.

2. What will 759¾ yards come to, at 3d. per yard?

s. d.

|3d.|¼|759 9 value at 1s. per yard.

2|0)18|9 11¼

Anſ. 9 9 11¼ value at 3d. per yard.

Or, thus:

£. s. d.

|3d.|¼|37 19 9 value at 1s. per yard.

Anſ. £9 9 11¼ value of 759¾ yds. at 3d. per yd.

Queſtions. Yds.		£.	s.	d.
3d.	642 at ¼d. per yd.	0	13	4½
4th.	918¼—½d. ——	1	18	3⅛
5th.	739½—1d. ——	3	1	7½
6th.	567½—1½d. ——	3	10	11¼
7th.	685¾—2d. ——	5	14	3½
8th.	475¼—4d. ——	7	18	5
9th.	913½—6d. ——	22	16	9

CASE II.

When the price is pence, and no even part of a ſhilling: Find the value of the given quantity at 1s. per yard; divide the pence into aliquot parts, for diviſors; and the ſum of the quotients, ariſing from them, will be the anſwer.

EXAMPLES.

1. What will 487½ yards come to, at 5d. per yard?

		£.	s.	d.	
3d.	¼	24	7	6	value of 487½ yards, at 1s. per yd.
2d.	⅙				
		6	1	10½	value of ditto, at 3d. per yard.
		4	1	3	value of ditto, at 2d. per yard.
Anſ.		£10	3	1½	value of ditto, at 5d. per yard.

Queſtions. Yds.		£.	s.	d.
2d.	568¼ at 7d. ——	16	11	5¾
3d.	683¾ — 8d. ——	22	15	10
4th.	912½ — 9d. ——	34	4	4½
5th.	649¼ — 10d. ——	27	1	0½
6th.	745¾ — 11d. ——	34	3	7¼

CASE III.

When the price is pence or farthings, and an even part of a pound, cut off the right hand figure of the given quantity ; and the cypher, in the aliquot part (if it has one) and divide by the remaining figure or figures : When you come to the remainder, double it ; and divide as before : The anſwer will be pounds, ſhillings, &c. If there be no cypher in the diviſor, then none ſhould be cut off from the dividend.

EXAMPLES.

d.
$|\frac{1}{4}|\frac{1}{96\cdot0}|3795$ lb. at $\frac{1}{4}$d.
$96=8\times12)379|5$*

8)31 12 6

Anſ. £3 19 0$\frac{3}{4}$

$|\frac{3}{4}|\frac{1}{32\cdot0}|$ 3795 yds. at $\frac{3}{4}$d.
$32=4\times8)379|5$

4)47 8 9

Anſ. £11 17 2$\frac{1}{4}$

d.
$|1\frac{1}{2}|\frac{1}{16\cdot0}|3795$ yds. at 1$\frac{1}{2}$d.

$16=4\times4)379|5$

4)94 17 6

£23 14 4$\frac{1}{2}$ *Anſ.*

d.
$|\frac{1}{2}|\frac{1}{48\cdot0}|3795$ yds. at $\frac{1}{2}$d.
$48=6\times8)379|5$

6)47 8 9

Anſ. £7 18 1$\frac{1}{2}$

$|1|\frac{1}{24\cdot0}|$ 3795 yds. at 1d.
$24=4\times6)379|5$

4)63 5

Anſ. £15 16 3

d.
$|2|\frac{1}{12\cdot0})379|5$ yds. at 2d.

£31 12 6 *Anſ.*

d.
$|3|\frac{1}{8\cdot0}|379|5$ yds. at 3d.

£47 8 9 *Anſ.*

d.

---

* In dividing by 12, there remains 7 before the ſtroke, which ſeparates the 5 ; then 75 doubled, is 150 ; and 12 is found 12$\frac{1}{2}$ times in 150 ; which makes 12s. 6

d.
|4|$\frac{1}{60}$|379|5 yds. at 4d.

£63 5 *Anſ.*

d.
|6|$\frac{1}{40}$|379|5 yds. at 6d.

£94 17 6 *Anſ.*

d.
|8|$\frac{1}{30}$|379|5 yds. at 8d.

£126 10 *Anſ.*

d.
|10|$\frac{1}{24}$|3795 yds.

24=4×6)3795

4)632 10

£158 2 6 *Anſ.*

C A S E IV.

When the price is between one and two ſhillings;—Find the value of the quantity at 1s. per yard, &c. which value being divided by *thoſe even parts* which the pence are of 1s and the quotient or quotients, ariſing therefrom, added thereto;—the ſum will be the anſwer.

EXAMPLES.

1. What will 758½ yards, at 1/9 per yard, come to?

		£.	s.	d.	
6d.	½	37	18	6	value at 1s. per yard.
3d.	¼	18	19	3	value at 6d. per yard.
		9	9	7½	value at 3d. per yard.

Anſ. £66 7 4½ val. of 758½ yds. at 1/9 per. yd.

Queſtions.				Anſwers.		
	Yds.			£.	s.	d.
2d.	987½	at	12½d. —	51	8	7¾
3d.	793	—	12¾d. —	42	2	6¾
4th.	847½	—	1s. 1d. —	45	18	1½

Queſtions.

Queſtions.			Anſwers.		
	Yds.		£.	s.	d.
5th.	686¾	at 1s. 1½d.—	38	12	7
6th.	591¼	— 1s. 2d. —	34	9	9½
7th.	573½	— 1s. 3d. —	35	16	10½

CASE V.

When the price is any even number of ſhillings under 20;—Multiply the given quantity, by half the price; and double the firſt figure of the product for ſhillings; the reſt of the product will be pounds.

N. B. If the price be 2s. you need only double the unit figure for ſhillings; the other figures will be pounds.

EXAMPLES.

1. What will 746 yards coſt, at 2s. per yard?

746

Anſ. £74 12 value at 2s. per yard.

Note. The above is done, by ſaying, twice 6 (the unit figure) is 12; the other figures, viz. 74, are pounds.

2. What will 567¾ yards, at 2s. per yard, come to?

Anſ. £56 15/6.

N. B. Before I double the unit figure, viz. 7, I conſider, that ¾ of a yard, at 2s. per yard, will amount to 1/6; then, I double 7, which makes 14s. and 1/6 added, makes 15/6; the other figures are pounds.

Queſtions.			Anſwers.		
	Yds.		£.	s.	d.
3d.	129½	at 4s. per yard,	25	18	0
4th.	697	— 6s. — —	209	2	0
5th.	845	— 8s. — —	338	0	0
6th.	917¼	—10s. — —	458	12	6

CASE

CASE VI.

When the price wants an even part of 2s.—Firſt, find the value of the whole quantity at 2s. per lb. yard, &c. then divide it by *that even part* which is wanting; and ſubtract this quotient from the value at 2s. the remainder will be the anſwer.

EXAMPLES.

1. What will 95½ yards coſt, at 22d. per yard?

		£.	s.	d.	
2d.	$\frac{1}{12}$	9	11	0	value at 2s. per yard.
		0	15	11	ditto at 2d. per yard.
	Anſ.	£8	15	1	value at 1s. 10d. per yard.

Queſtions.	Yds.			Anſwers. £.	s.	d.
2d.	64	at 23d.	per yard	6	2	8
3d.	128	— 22½d.	———	12	0	0
4th.	246½	— 21d.	———	21	11	4½
5th.	375¼	— 20d.	———	31	5	5

CASE VII.

When the price is between 2s. *and* 3s.—Firſt, find the value of the quantity, at 2s. per yard, &c. which value being divided by *thoſe even parts*, which the pence are of 2s. and thoſe quotients added thereto, the ſum will be the anſwer.

EXAMPLES.

1. What will 148½ yards come to, at 2s. 7d. per yard?

		£.	s.	d.	
4d.	$\frac{1}{6}$	14	17	0	value at 2s. per yard.
3d.	$\frac{1}{8}$	2	9	6	ditto at 4d. per yard.
		1	17	1½	ditto at 3d. per yard.
	Anſ.	£19	3	7½	value at 2s. 7d. per yard.

Queſtions.

Queſtions.			Anſwers.		
	Yds.		£.	s.	d.
2d.	266¼	at 2s. 1d. per yard,	27	14	8¼
3d.	344	— 2s. 1½d. ———	36	11	0
4th.	543½	— 2s. 2d. ———	58	17	7
5th.	655¾	— 2s. 3d. ———	73	15	5¼

CASE VIII.

When there are pence in the price which are an even part of a ſhilling, beſides an even number of ſhillings under 20;—Firſt, find the value of the quantity at the ſhillings per yard, &c. according to Caſe 5th; then, ſuppoſe the quantity to ſtand as ſhillings per yard; divide it by *that even part*, which the pence are of 1s. and this quotient being added to the value before found, the ſum will be the anſwer.

EXAMPLES.

1. What will 156½ yards come to, at 6s. 4d. per yard?

Yds.
156½
d. s. d. 3
4|⅓|156 6 ————
———— £46 19 0 value of 156½ yds. at 6s. per yd.
52s. 2d.=2 12 2 value of ditto at 4d. per yd.

Anſ. £49 11 2 value of ditto at 6/4 per yard.

Queſtions.				Anſwers.		
	Yds.		s. d.	£.	s.	d.
2d.	17½	at	4 0½ per yard	3	10	8¼
3d.	59¾	—	6 0¾ — —	18	2	2¾
4th.	68¼	—	8 1 — —	27	11	8¼
5th.	96	—	10 1½ — —	48	12	0

CASE IX.

When the price is any odd number of ſhillings under 40;—Find the value of the greateſt even number contained in the price, according to Caſe 5th, and add thereto the value of the quantity at 1s. per yard, &c. which ſum will be the anſwer : *Or*, Multiply the quantity by the price, according to the 1ſt or 2d Caſe, in Simple Multiplication ; and divide the product by 20 ; the quotient will be the anſwer : *Or*, laſtly, if the price be under 13s. find the value of the quantity at 1s. per yard, &c. and multiply it by the number of ſhillings in the price of 1 yard : The product will be the anſwer.

EXAMPLES.

1. What will 186 yards coſt, at 3s. per yard ?

£. s.
18 12 value at 2s. per yd.
9 6 value at 1s. per yd.
£27 18 *Anſ.*

Or thus :
£. s.
9 6 value at 1s. per yd.
3
Product 27 18 *Anſwer.*

2. What will 647 yards coſt, at 17s. per yard ?
8

£517 12 value at 16s. per yard.
32 7 value at 1s. per yard.

Anſ. £549 19 value at 17s per yard.

Queſtions.				Anſwers.		
	Yds.	s.		£.	s.	d.
3d.	169¼ at	5	per yard,	42	6	3
4th.	248¾ —	7	- - -	87	1	3
5th.	139 —	9	- - -	62	11	0
6th.	782 —	25	- - -	977	10	0

CASE X.

When the price is an even part of a pound ;—Find the value of the given quantity, at one pound per yard, &c. then draw a line underneath, and divide it by that *part* ; the quotient will be the anſwer.

EXAMPLES.

EXAMPLES.

1. What will 156¾ yards of cloth come to, at 3s. 4d. per yard?

£. s. d.
|3s. 4d. | ⅙ | 156 15 0 price at £1 per yard.

Anſ. £26 2 6 price at 3s. 4d. per yard.

Queſtions.						Anſwers.		
	Yds.		s.	d.		£.	s.	d.
2d.	516¾	at	1	0	per yard,	25	16	9
3d.	624	—	1	3	———	39	0	0
4th.	719½	—	1	4	———	47	19	4
5th.	648	—	1	8	———	54	0	0

CASE XI.

When the price wants an even part of a pound;—Firſt, find the value of the given quantity at £1 per yard, &c. then divide it by *that even part* which is wanting, and ſubtract this quotient therefrom: The remainder will be the anſwer.

EXAMPLES.

1. What will 167½ yards coſt, at 17s. 6d. per yard?

s. d. £. s. d.
|2 6 | ⅛ | 167 10 0 value at £1 per yard.
20 18 9 value at 2s. 6d. per yard.

Anſ. £146 11 3 value at 17s. 6d. per yard.

Queſtions.						Anſwers.		
	Yds.		s.	d.		£.	s	d.
2d.	347½	at	13	4	per yard,	231	13	4
3d.	484¾	—	15	0	———	363	6	3
4th.	614	—	16	0	———	491	4	0
5th.	912¼	—	17	6	———	798	4	4½

CASE XII.

When the price is ſhillings, pence and farthings, and not an even part of a pound ;—Multiply the given quantity by the ſhillings in the price of 1 yard, &c. and take parts of parts from the quantity for the pence, &c. then add them together, and their ſum will be the anſwer, in ſhillings, &c. *Or*, you may let the given quantity ſtand as pounds, per yard, &c. then draw a line underneath, and take parts of parts therefrom ; which add together, and their ſum will be the anſwer.

N. B. I adviſe the learner to work the following examples both ways ; by which means he will be able to diſcover the moſt conciſe method of performing ſuch queſtions in buſineſs, as may fall under this caſe.

What will 248½ yards, at 7s. 6d. per yard, come to?

s.	s.	d.	
|6|½|	248	6	value of 248½ yards, at 1s. per yard?
		7	
	1739	6	value of ditto, at 7s. per yard.
	124	3	value of ditto, at 6d. per yard.
2|0)	186|3	9	
Anſ. £93	3	9	value of ditto, at 7s. 6d. per yard.

Or thus :

d.	£.	s.	d.	
|6|½|	12	8	6	value of 248½ yards, at 1s. per yard.
Mult. by			7	
	86	19	6	value of ditto, at 7s. per yard.
	6	4	3	value of ditto, at 6d. per yard.
Anſ.	£93	3	9	

By the latter part of this Caſe.

s. d.		£.	s.	d.	
5 0	1/4	248	10	0	value of 248½ yards, at £1 per yard.
2 6	1/2	62	2	6	value of ditto, at 5s. per yard.
		31	1	3	value of ditto, at 2s. 6d. per yard.
		Anſ. £93	3	9	value of ditto, at 7s. 6d. per yard.

Queſtions.						Anſwers.		
	Yds.		s.	d.		£.	s.	d.
2d.	68½	at	4	6	per yard,	15	8	3
3d.	124	—	5	8	- - - - -	35	2	8
4th.	146	—	14	9	- - - - -	107	13	6
5th.	218½	—	12	6	- - - - -	136	11	3

C A S E XIII.

When the price of the yard, lb. *&c. is pounds, ſhillings and pence ;*—Firſt multiply the quantity by the pounds ; and if the ſhillings and pence be an even part of a pound, divide the given quantity by *that part*, and add the quotient to the product for the anſwer : But if they be not an even part of a pound, you muſt take parts of parts, and add them together as before.——*Or*, Reduce the pounds and ſhillings into ſhillings, and multiply the quantity thereby, after which, take parts for the pence, and add the whole together, and their ſum will be the anſwer in ſhillings, &c.

N. B. The learner ſhould work the following queſtions both ways.

EXAMPLES.

1. What will 156 yards of broad cloth come to, at £3 6/8 per yard ?

		£.			
6/8	1/3	156	0	0	value at one pound per yard.
				3	
		468	0	0	
		52	0	0	
		Anſ. £520	0	0	

Queſtions.

Queſtions.							Anſwers.		
	Yds.		£.	s.	d.		£.	s.	d.
2d.	345½	at	6	5	0	per yard,	2159	7	6
3d.	59¾	—	3	6	8	- - - -	199	3	4
4th.	75	—	5	3	4	- - - -	387	10	0
5th.	68	—	4	6	0	- - - -	292	8	0

C A S E XIV.

When the quantity is any number leſs than 1000, *and the price not more than* 12d. *per yard, &c.*—Find the value of the whole quantity at 1d. per yard, which may be done by dividing it by 12, *mentally*, ſetting down the quotient only in pounds, or ſhillings, or both: Then multiply this ſum by the pence in the price of one yard, and the product will be the anſwer.

1. What will 759½ yards coſt, at 7d. per yard?

£. s. d.
0 63 3½ value at 1d. per yard.

Or, 3 3 3½
Mult. by 7

Anſ. £22 3 0½ val. of 759½ yards, at 7d. per yard.

Queſtions.					Anſwers.		
	Yds.		d.		£.	s.	d.
2d.	975½	at	2	per yard,	8	2	7
3d.	846	—	3½	- - - -	12	6	9
4th.	793¾	—	4¾	- - - -	15	14	2¼
5th.	684	—	5½	- - - -	15	13	6

C A S E XV.

When the price is ſuch a number of ſhillings and pence, as, when reduced into pence, may be produced by any two numbers in the Multiplication Table, and when the quantity does not exceed 1000;—Firſt find the value of the whole at 1d. per yard, &c. according to the laſt Caſe; then, multiply this ſum by the component parts of the pence in the price, and the laſt product will be the anſwer.

EXAMPLES.

EXAMPLES.

1. What will 439½ yards coſt, at 6s. 9d. per. yard?

£. s. d.
1 16 7½ value at 1d. per yard.
9

16 9 7½
9

Anſ. £148 6 7½ value at 81d. or 6s. 9d. per yard.

N. B. In 6s. 9d. there being 81 pence, I multiply by 9 twice, becauſe 9 times 9 is 81.

Queſtions.						Anſwers.		
	Yds.		s.	d.		£.	s.	d.
2d.	984½	at	1	2	per yard,	57	8	7
3d.	849¾	—	2	8	- - - -	113	6	0
4th.	657	—	3	6	- - - -	114	19	6
5th.	593	—	4	8	- - - -	138	7	4

CASE XVI.

When the quantity is 240;—As many pence as there are in the price of 1 yard, &c. ſo many pounds will the quantity amount to.

N. B. One farthing per yard will come to 5s. at halfpenny per yard, to 10s. and at three farthings to 15s.

EXAMPLES.

1. What will 240 yards come to, at 2s. 7½d per yard? *Anſ.* £31 10s.

N. B. The price is 2/7½ per yard:—Now, as in 2/7 there [illegible] 31 pence, ſo the quantity being 240, comes to 31 pound[illegible] then, according to the ſame rule, the halfpenny per [illegible] comes to 10s. therefore, the anſwer to the queſtion is £[illegible]

Queſtions.						Anſwers.	
	Yds.		s.	d.		£.	s.
2d.	240	at	1	7¾	per yard,	19	15
3d.	240	—	2	9	- - - -	33	0
4th.	240	—	3	4	- - - -	40	0
5th.	240	—	7	8½	- - - -	92	10

CASE XVII.

When the quantity is not leſs than 228, *nor more than* 252;—Firſt find the value of 240 yards, &c. by the laſt Caſe; then multiply the price of 1 yard by the number *above* or *under* 240, and add or ſubtract this product, to or from the value of 240 yards, as the queſtion may require; and the ſum or remainder will be the anſwer.

EXAMPLES.

1. What will 248 yards come to, at 16s. 5½d. per yard?

£. s. d.
197 10 0 value of 240 yards.
16/5½ multiplied by 8=6 11 8 value of 8 yards.

Anſ. £204 1 8 value of 248 yards.

2. What will 229 yards coſt, at 5s. 9¾d. per yard?

69 15 0 value of 240 yards.
5/9¾ multiplied by 11=3 3 11¼ value of 11 yards.

Anſ. £66 11 0¾ value of 229 yards.

Queſtions.					Anſwers.		
	Yds.	s.	d.		£.	s.	d.
3d.	228 at	6	10½	per yard,	78	7	6
4th.	252 —	4	6	- - - -	56	14	0

CASE XVIII.

When the price of one hundred weight is of ſeveral denominations, and the quantity likewiſe;—Multiply the price by the integers, (that is, the whole numbers) and take parts for the reſt from the price of an integer; which, added together, will be the anſwer.

EXAMPLES.

1. What will 9Cwt. 3qrs. 14lb. of ſugar come to, at £4 17s. 4d. per Cwt.?

qrs.

qrs.	lb.		£.	s.	d.		Cwt.	qrs.	lb.
2	0	½	4	17	4	price of 1 Cwt.			
1	0	½			9				
0	14	½							
			43	16	0	price of	9	0	0.
			2	8	8	price of	0	2	0
			1	4	4	price of	0	1	0
			0	12	2	price of	0	0	14
		Anſ.	£48	1	2	price of	9	3	14.

Queſtions.									Anſwers.		
	Cwt.	qrs.	lb.		£.	s.	d.		£.	s.	d.
2d.	8	1	16	tobacco, at	5	17	9	per cwt.	49	8	2¾
3d.	7	3	19	- - - - - -	7	12	8	- - - - -	60	9	0½
4th.	12	1	24	- - - - - -	3	18	10	- - - - -	49	2	7¾
5th.	16	2	17	- - - - - -	2	15	11	- - - - -	46	11	1

CASE XIX.

When the price is at any of the rates in the ſecond Practice Table of aliquot parts ;—Multiply the given quantity by the numerator, and divide that product by the denominator ; if the price be pence, the quotient will be the anſwer in ſhillings ; if ſhillings, the anſwer will be pounds.

EXAMPLES.

1. What will 379 yards, at 4½d. per yard, come to ?

379
3
8)1137
2|0)14|2 1½
Anſ. £7 2 1½

2. What will 149 yards, at 6s. per yard, come to ?

149
3
1|0)44|7
Anſ. £44 14

Queſtions.	Yds.		s.	d.		Anſwers. £.	s.	d.
3d.	127	at	0	7½	per yard,	3	19	4½
4th.	159	—	0	8	- - - -	5	6	0
5th.	173	—	0	9	- - - -	6	9	9
6th.	241	—	0	10	- - - -	10	0	10
7th.	249	—	7	6	- - - -	93	7	6
8th.	357	—	12	6	- - - -	223	2	6
9th.	345	—	13	4	- - - -	230	0	0

C A S E XX.

When the price is any even number of ſhillings, if it be required to know what quantity of any thing may be bought for ſo much money;—Annex a cypher to the money, and divide it by half the price, and the quotient will be the quantity to be purchaſed.

EXAMPLES.

1. How many yards of cloth, at 18s. per yard, may I have for £345?

Half the price=9)3450=*Money with a cypher annexed.*

383⅓ Yards, *Anſwer.*

Queſtions.	s.		£.	Anſwers. Yds.
2d. How many yds. at	2	per yd. for	427?	4270
3d. - - - - - - - - - -	4	- - - -	312	1560
4th. - - - - - - - - - -	6	- - - -	917	3056⅔
5th. - - - - - - - - - -	8	- - - -	195	487½

C A S E XXI.

To find the diſcount of any invoice, or bill of parcels, at any rate per cent.——Multiply the pounds in the invoice by the amount of the diſcount of one pound, at the rate per cent. and take parts for the ſhillings and pence; then add them together, and the ſum will be the diſcount required.

N. B. The diſcount for 1 pound at any rate per cent. is in the 3d Practice Table, page 184.

EXAMPLES.

EXAMPLES.

1. What is the diſcount of an invoice, amounting to £65 13s. 4d. at £7½ per cent. ?

OPERATION.	£.	s.	d.
The diſcount of £65 at £5 per cent. is 65s. or	3	5	0
The diſcount of £65 at £2½ per cent. is -	1	12	6
The diſcount of 10s. being half a pound, at £7½ per cent. is - - - - - - - -	0	0	9
The diſcount of 3s. 4d. being ⅓ of a pound, at £7½ per cent. is - - - - - - -	0	0	3
The ſum is,	£4	18	6

(*Anſwer.*

N. B. When the rate per cent. is any even part of £100, it may be performed, by dividing the amount by *that even* part.

2. What is the diſcount of an invoice amounting to £57 13s. 9d. at £12½ per cent. ?

		£.	s.	d.
12½	⅛	57	13	9
		£7	4	2½ *Anſwer.*

CASE XXII.

To find the value of goods ſold by particular quantities, viz. I. By the Score. II. Round Timber. III. By 5 Score to the Hundred. IV. By 112 to the Hundred. V. By 6 Score to the Hundred. VI. By the great Groſs. VII. By the 1000.

I. *To find the value of goods ſold by the Score.*

The price of one is given to find the price of one ſcore.

If the given price be ſhillings and pence, or only pence——*Divide* the given price, in pence, by 12 : The quotient will be the anſwer in pounds, and the remainder will be ſo many times 1/8.

EXAMPLES.

EXAMPLES.

1. At 9d. each; what is that per ſcore?

12)9d.(,75=£0 15 0 *Anſ.*

Or, by inverting the queſtion.

1 Score=20= 1/8
9
15/0

2. At 4/9 each; wha
is that per ſcore?

4/9
12

12)57d.

£4 15 *Anſwer.*

It may be remarked, that when the price is ſhillings and pence, the anſwer will be juſt ſo many pounds as there are ſhillings, and ſo many times 1/8 as there are pence: If farthings are given; for $\frac{1}{4}$d. reckon 5d. for $\frac{1}{2}$d. 10d. and for $\frac{3}{4}$d. 1/3.

TABLE *of aliquot parts.* 20 *the* Integer.

2	is	$\frac{1}{10}$	6	is	$\frac{3}{10}$	12	is	$\frac{6}{10}$	16	is	$\frac{8}{10}$
4	—	$\frac{1}{5}$	8	—	$\frac{4}{10}$	14	—	$\frac{7}{10}$	18	—	$\frac{9}{10}$
5	—	$\frac{1}{4}$	10	—	$\frac{1}{2}$	15	—	$\frac{3}{4}$			

3. What coſt 17, at 19/10 per ſcore?

		s.	d.
		19	10
10	$\frac{1}{2}$	9	11
5	$\frac{1}{4}$	4	11$\frac{1}{2}$
2	$\frac{1}{10}$	1	11$\frac{3}{4}$
17	=	16	10$\frac{1}{4}$

II. *Round Timber.*

Forty feet make a load, or ton, of round timber.

If the given price of a foot be ſhillings;—Multiply the given price by 2, and the product will be the anſwer in pounds.

4. What coſt a ton, at 3s. per foot?

3s. × 2=£6 *Anſwer.*

5. What coſt a ton, at 9s. per foot?

9s. × 2=£18 *Anſ.*

If the given price of 1 foot be pence only, or ſhillings and pence——*Divide* the given price, in pence, by 6;

the

ıe quotient will be the anſwer in pounds, and the remain-
er will be ſo many times 3/4.

6. What coſt 40 feet
: 17d. per foot ?

6)17

£2 16 8 *Anſwer.*

7. At 1/9 per foot, what coſt a ton ?

6)21

£3 10

If the given price of a foot be farthings only, or pence
ıd farthings——*Divide* the given price, in farthings, by
, then, divide *that quotient* by 4, and *this laſt quotient* will
ₑ the anſwer.

8. At ¾d. per foot,
hat coſt a ton ?

6)3

4)– 10

£– 2 6 *Anſwer.*

9. At 13¼d. per foot, what coſt a ton ?

13¼
4

6)53

4)8 16 8

£2 4 2 *Anſ.*

Or, Suppoſe every ſhilling in the price to be ſo many
ıes £2 : Every penny to be ſo many times 3/4 : And
ery farthing to be 10d.

10. What coſt 40 feet,
¾d. per foot ?

l. × 10=£0 2 6 *Anſ.*

11. What coſt 40 at 15½d. per foot ?

s.	d.				
1	0 × 2=	£2	0	0
3	4 × 3=	0	10	0
	½ × 10=	0	1	8
		£2	11	8 *Anſ.*

.I. *To find the value of goods ſold by 5 Score to the Hundred.*

1. *If the given price be pounds and ſhillings, or ſhillings
ly*——Multiply the given price, in ſhillings, by 5 ; and
e quotient will be the anſwer, in pounds.

12. At 19s. per yard, what coſt 100 yards?

19s.
5
£95 *Anſ.*

13. At £4 13s. per cwt. what coſt 100 cwt. or 5 tons?

4 13
20
93
5
£465 *Anſ.*

2. *If the given price of* 1, *be pence only, or ſhillings and pence*——Multiply the given price, in pence, by 5; then divide that product by 12; the quotient will be pounds, and the remainder ſo many times 1s. 8d.

14. If 1 yard coſt 9d.; what coſt 100 yards?

9
5
12)45
£3 15 *Anſwer.*

3. *If the given price of* 1, *be ſhillings and pence*—Multiply the price by 5, and the product, under the place of ſhillings, will be the anſwer in pounds; and the product under the place of pence, will be ſo many times 1s. 8d.

15. At 2/5 per buſhel; what coſt 100 buſhels?

s. d.
2 5
5
12 1
Anſ £12 2 8

16. At 25/3 per ton; what coſt 100 tons?

s. d.
25 3
5
126 3 1/8×3=5s.
£126 5 *Anſ.*

IV. *To*

4. *To find the price of* one, *at ſo much per hundred of* 5 *ſcore.*—Multiply the given price by 12; divide the product by 5, and the quotient will be the anſwer in pence.

But if the price be pounds only; Divide the given price by 5, and the quotient will be the anſwer in ſhillings.

17. If 100 yards coſt £65; what coſt 1 yard?

5)65

13s. *Anſ.*

18. If 100 yards coſt £11 17s. 9d. what coſt 1 yard?

£11 7 9
12

5)136 13 0

12)27 6 7

2s. $3\frac{1}{2}$d. *Anſ.*

In dividing 27 by 12 (in the 18th queſtion) the quotient is 2s. and the remainder 3d.—the 6 is $\frac{6}{10}$ of a penny=two farthings, and the 7 is of no account.

TABLE *of Aliquot Parts.* 100 *the* Integer.

5	is	$\frac{1}{20}$	25	is	$\frac{1}{4}$	50	is	$\frac{1}{2}$	75	is	$\frac{3}{4}$
10	—	$\frac{1}{10}$	30	—	$\frac{3}{10}$	60	—	$\frac{6}{10}$	80	—	$\frac{8}{10}$
20	—	$\frac{1}{5}$	40	—	$\frac{4}{10}$	70	—	$\frac{7}{10}$	90	—	$\frac{9}{10}$

19. At £3 7/6 per 100; what will 23 coſt?

		£.	s.	d.	
20	$\frac{1}{5}$	3	7	6	
		0	13	6	
2	$\frac{1}{10}$	0	1	4	Add.
1	$\frac{1}{2}$	0	0	9	
23 =		£0	15	6 *Anſ.*	

IV. *To find the value of goods ſold by* 112lb. *the cwt.*

The price of 1lb. is given to find the value of a cwt.

Rule. For a farthing, account 2/4 per cwt. For a half penny, 4/8. For three farthings, 7s. and for every penny, 9/4 per cwt.

20. What coſt 1cwt. at 3½d. per lb.?

At 1d. per lb. s. d.
1cwt. coſts - 9 4
3

At 3d. £1 8 0 } *Add.*
At ½d. £0 4 8

£1 12 8 *Anſ.*

21. At 8¾d. per lb. what coſt 1 cwt.?

At 1d. per lb. s. d.
1cwt. coſts - 9 4
8

At 8d. £3 14 8 } *Add.*
At ¾d. £0 7 0

Anſ. £4 1 8

V. *To find the value of goods ſold by 6 ſcore to the hundred.*

The price of one is given, to find the price of one hundred.

Rule. Suppoſe every penny in the price to be ſo many pounds, and for the farthings, ſuch a part of a pound, as they are of a penny; then, half of that ſum will be the anſwer.

22. At 4½d. per yard, what coſt 120 yards?

£. s.
2)4 10

£2 5 *Anſ.*

23. At 16s. 9¼d. per yard, what coſt 120 yards?

16s. 9¼d.
12

201

£. s.
2)201 5

£100 12 6 *Anſ.*

To find the price of one, *at ſo much per hundred of* 6 *ſcore.*

Rule. Multiply the price by 2, then call the pounds ſo many pence, and the ſhillings, ſuch a part of a penny, as they are of a pound, and you will have the anſwer.

24. If 120 yards coſt £3 12s.; what coſt 1 yard?

£. s.
3 12
2
7 4

Anſ. 7$\frac{1}{5}$d.

25. If 120 yards coſt £5 18s. 6d.; what coſt 1?

£. s. d.
5 18 6
2
11 17 0

Anſ. 11$\frac{3}{4}$d. + $\frac{2}{5}$ of a farth.

TABLE *of Aliquot Parts*, 120 *the* Integer.

						Alſo,								
6	is	$\frac{1}{20}$	24	is	$\frac{1}{5}$	36	is	$\frac{3}{10}$	72	is	$\frac{3}{5}$	96	is	$\frac{4}{5}$
10	—	$\frac{1}{12}$	30	—	$\frac{1}{4}$	45	—	$\frac{3}{8}$	75	—	$\frac{5}{8}$	100	—	$\frac{5}{6}$
12	—	$\frac{1}{10}$	40	—	$\frac{1}{3}$	48	—	$\frac{2}{5}$	80	—	$\frac{2}{3}$	105	—	$\frac{7}{8}$
15	—	$\frac{1}{8}$	60	—	$\frac{1}{2}$	50	—	$\frac{3}{12}$	84	—	$\frac{7}{10}$	108	—	$\frac{9}{10}$
20	—	$\frac{1}{6}$				70	—	$\frac{7}{12}$	90	—	$\frac{3}{4}$	110	—	$\frac{11}{12}$

26. At £3 17s. 6d. per hundred; what coſt 14?

		£. s. d.
12	$\frac{1}{10}$	3 17 6
		0 7 9 } *Add.*
2	$\frac{1}{6}$	0 1 3$\frac{1}{2}$ }
14	=	£0 9 0$\frac{1}{2}$ *Anſ.*

27. At £1 19s. 3d. per hundred; what coſt 75?

£. s. d.
1 19 3
5
8)9 16 3
£1 4 6$\frac{1}{4}$ *Anſ.*

VI. *To*

VI. *To find the value of goods ſold by the Great Groſs.*

Note. 12 make 1 dozen, 12 dozen 1 ſmall groſs, 12 ſmall groſs 1 great groſs.

The price of one dozen being given, in pence, to find the price of a great groſs.

Rule. Multiply the price of 1 dozen, in pence, by 3, then divide that product by 5, and the quotient will be the anſwer in pounds, &c.

For proof, do the contrary.

N. B. If the price of 1 be given, the price of 1 ſmall groſs is found after the ſame manner.

28. At 18d. per dozen; what coſt 1 great groſs?

18d.
3
5)54
£10 16 *Anſ.*

29. At 4s. 3d. per dozen; what coſt 1 great groſs?

4s. 3d.
12
51d.
3
5)153
Anſ. £30 12

Or,
s. d.
4 3
12
2 11 0
12
£30 12 0

TABLE *of Aliquot Parts.* 144 *the* Integer.

Alſo,

12 is	$\frac{1}{12}$	36 is	$\frac{1}{4}$	32 is	$\frac{2}{9}$	84 is	$\frac{7}{12}$	128 is	$\frac{8}{9}$
16 —	$\frac{1}{9}$	48 —	$\frac{1}{3}$	60 —	$\frac{5}{12}$	96 —	$\frac{2}{3}$	132 —	$\frac{11}{12}$
18 —	$\frac{1}{8}$	72 —	$\frac{1}{2}$	64 —	$\frac{4}{9}$	108 —	$\frac{3}{4}$		
24 —	$\frac{1}{6}$			80 —	$\frac{5}{9}$	120 —	$\frac{5}{6}$		

30. What coſt 117 dozen, at £9 13s. 7d. per great groſs?

Doz.		£. s. d.
		9 13 7
		3
108	¾	29 0 9
9	1/12	7 5 2¼ } *Add.* 0 12 1¼ }
117	=	£7 17 3½ *Anſ.*

31. At £3 16s. 8d. per great groſs; what coſt 7 great groſs, and 96 dozen?

£. s. d.
3 16 8
2

3)7 13 4
Doz.
96 = 2 11 1¼
Top line × 7 = 26 16 8

£29 7 9¼ *Anſ.*

VII. *To find the value of goods ſold by the Thouſand.*

The price of 1 is given to find the price of 1000.

Rule. Multiply the given price in pence, by 50; then, divide the product by 12, and the quotient will be the anſwer in pounds, &c.

32. At 6d. each; what coſt 1000?
6
50

12)300

£25 *Anſ.*

Or, as 1000s. are £50; take parts for the pence, out of 50.

| 6d. | ½ | 50

25 *Anſ.*

To find the price of *one*, at ſo much per thouſand.

Rule. Multiply the price by 12; divide the product by 50; then take the pounds for ſo many pence, and the ſhillings, for ſuch a part of a penny as they are of a pound, which will be the anſwer.

33. At £354 3s. 4d. per 1000; what coſt 1?

£. s. d.
354 3 4
12
50 { 10)4250 0 0
5)425
85

Anſ. 7s. 1d.

Or,

		£.	s.	d.
100	$\frac{1}{10}$	354	3	4
10	$\frac{1}{10}$	35	8	4
1	$\frac{1}{10}$	3	10	10
	Anſ.	0	7	1

TABLE *of Aliquot Parts.* 1000 *the* Integer.

		Alſo,	
50 is $\frac{1}{20}$	200 is $\frac{1}{5}$	300 is $\frac{3}{10}$	700 is $\frac{7}{10}$
100 — $\frac{1}{10}$	250 — $\frac{1}{4}$	375 — $\frac{3}{8}$	750 — $\frac{3}{4}$
125 — $\frac{1}{8}$	500 — $\frac{1}{2}$	400 — $\frac{2}{5}$	800 — $\frac{4}{5}$
		600 — $\frac{3}{5}$	875 — $\frac{7}{8}$
		625 — $\frac{5}{8}$	900 — $\frac{9}{10}$

34. At £1 17s. 9d. per 1000; what coſt 115?

		£.	s.	d.
100	$\frac{1}{10}$	1	17	9
10	$\frac{1}{10}$	0	3	$9\frac{1}{4}$
		0	0	$4\frac{1}{2}$
5	$\frac{1}{2}$	0	0	$2\frac{1}{4}$
115	=	£0	4	4 *Anſ.*

Add.

35. At £2 1s. 8d. per 1000; what coſt 875?

£. s. d.
2 1 8
7
8)14 11 8
£1 16 $5\frac{1}{2}$ *Anſ.*

BILL OF PARCELS.

Newburyport, January 1ſt, 1793.

Mr. Timothy Huckſter

Bought of *Samuel Merchant,*

25½lb. Bohea tea, at 3s. 6d. per lb.
48lb. cheeſe, at 9d. per lb.
15 pair of worſted hoſe, at 5s. 8d. per pair.
4½ dozen women's gloves, at 36s. 6d. per dozen.
19 dozen knives and forks, at 5s. 9d. per dozen.
9 grindſtones, at 15s. 9d. per ſtone.
½ cwt. brown ſugar, at 51s. per cwt.
31lb. loaf ſugar, at 1s. ½d. per lb.

£34 3 3½

Received payment in full,

Samuel Merchant.

TARE AND TRET.

Tare and Tret are practical rules for deducting certain allowances, which are made by merchants and tradeſman in ſelling their goods by weight.

Tare is an allowance, made to the buyer, for the weight of the box, barrel or bag, &c. which contains the goods bought, and is either at ſo much per box, &c. at ſo much per *cwt.* or at ſo much in the groſs weight.

Tret is an allowance of 4lb. in every 104lb. for waſte, duſt, &c.

Cloff is an allowance of 2lb. upon every 3cwt.

Groſs weight is the whole weight of any ſort of goods, together with the box, barrel or bag, &c, which contains them.

Suttle is when part of the allowance is deducted from the groſs.

Neat weight is what remains after all allowances are made.

CASE

CASE I.*

When the tare is at ſo much per box, barrel or bag, &c. — Multiply the number of boxes, barrels, &c. by the tare, and ſubtract the product from the groſs, and the remainder will be the neat weight required.

EXAMPLES.

1. In 6 hogſheads of ſugar, each weighing 9cwt. 2qrs. 10lb. groſs, tare 25lb. per hogſhead; how much neat?

	Cwt.	qr.	lb.	Cwt.	qr.	lb.	
25 × 6 =	1	1	10	9	2	10	groſs wt. of 1 hhd.
						6	
				57	2	4	groſs.
				1	1	10	tare.
			Anſ.	56	0	22	neat.

2. In 5 bags of cotton, marked with the groſs weight as follows, tare 23lb. per bag; what neat weight?

	Cwt.	qrs.	lb.
A =	7	1	19
B =	3	3	27
C =	5	1	12
D =	6	0	15
E =	8	1	0

	Cwt.	qrs.	lb.	
Anſ.	30	0	14	neat.

3. What is the neat weight of 15 hogſheads of tobacco, each 7cwt. 1qr. 13lb. tare 100lb. per hhd.?

Anſ. 97cwt. 0qr. 11lb.

---

* This, as well as every other Caſe in this rule, is only an application of the rules of Proportion and Practice.

CASE II.

When the tare is at ſo much per cwt.—Divide the groſs weight by the aliquot parts of a cwt. Subtract the quotient from the groſs, and the remainder will be the neat weight.

EXAMPLES.

1. In 129cwt. 3qrs. 16lb. groſs; tare 14lb. per cwt. what neat weight?

lb.		Cwt.	qrs.	lb.	
14	$\frac{1}{8}$	129	3	16	groſs.
		16	0	26½	tare.
	Anſ.	113	2	17½	neat.

2. In 97cwt. 1qr. 7lb. groſs; tare 20lb. per cwt. what neat weight?

	lb.		Cwt.	qrs.	lb.	
	16	$\frac{1}{7}$	97	1	7	groſs.
	4	$\frac{1}{4}$	13	3	17	} *Add.*
			3	1	25	
Subtract			17	1	14	tare.
Anſ.			79	3	21	neat.

3. What is the neat weight of 9 barrels of pot-aſh, each weighing 305lb. groſs; tare 12lb. per cwt.?
Anſ. 2450lb. 14oz. 5drs.

CASE III.

When the tret is allowed with tare;—Divide the ſuttle weight by 26, and the quotient will be the tret, which ſubtract from the ſuttle and the remainder will be the neat.

EXAMPLES.

EXAMPLES.

1. In 247cwt. 2qrs. 15lb. groſs; tare 28 per cw and tret 4lb. per 104lb.; what neat weight?

lb.		Cwt.	qrs.	lb.		
28	$\frac{1}{4}$	247	2	15		groſs.
		61	3	17	12	tare, ſubtract.
4	$\frac{1}{26}$	185	2	25	4	ſuttle.
		7	0	16	0	tret, ſubtract.
	Anſ.	178	2	9	4	neat.

2. What is the neat weight of 4hhds. of tobacc weighing as follow; the 1ſt, 5cwt. 1qr. 12lb. groſs tare 65lb. per hogſhead; 2d, 3cwt. 0qr. 19lb. groſs; ta 75lb.; the 3d, 6cwt. 3qrs. groſs, tare 49lb.; and th 4th, 4cwt. 2qrs. 9lb. groſs; tare 35lb. and allowing tr to each as uſual? *Anſ.* 17cwt. 0qr. 19l

CASE IV.

When tare, tret and cloff are allowed;—Deduct the ta and tret as before, and divide the ſuttle by 168, and th quotient will be the cloff, which ſubtract from the ſuttl and the remainder will be the neat.

EXAMPLES.

1. What is the neat weight of a hogſhead of tobacc weighing 16cwt. 2qrs. 20lb. groſs; tare 14lb. per cw tret 4lb. per 104, and cloff 2lb. per 3cwt.?

	Cwt.	qrs.	lb.	oz.	
14lb. is $\frac{1}{8}$)	16	2	20	0	groſs.
	2	0	9	8	tare, ſubtract.
4lb. is $\frac{1}{26}$)	14	2	10	8	
	0	2	6	13	tret, ſubtract.
2lb. is $\frac{1}{168}$)	14	0	3	11	ſuttle.
	0	0	9	5	cloff, ſubtract.
Anſ.	13	3	22	6	neat.

2. If 9 hhds. of tobacco, contain 85cwt. 0qr. 2lb. re 30lb. per hhd. tret and cloff as uſual ; what will the eat weight come to, at 6½d. per lb. after deducting, for uties and other charges, £51 11s. 8d. ?

Anſ. £187 18s. 5d.

INVOLUTION,

OR, TO RAISE POWERS.

A Power is the product ariſing from multiplying any iven number into itſelf continually a certain number of imes, thus :

$3\times3=9$ is the 2d power, or ſquare of (3·$=3^2$

$3\times3\times3=27$ is the 3d power, or cube of (3·$=3^3$

$3\times3\times3\times3=81$ is the 4th power, or the biquad-(rate of 3, &c.$=3^4$

The number denoting the power is called the *Index*, or the *Exponent* of that power ; thus, the ſecond power of 5 is 25, or 5^2, &c.

$2\times2=4$, the ſquare of 2 : $4\times4=16=$4th power of 2 : $16\times16=256=$8th power of 2, &c.

Rule. Multiply the given number, root, or firſt power continually by itſelf, till the number of multiplications be one leſs than the index of the power to be found, and the laſt product will be the power required.

Note. Whence, becauſe fractions are multiplied by taking the products of their numerators, and of their denominators, they will be involved by raiſing each of their terms to the power required ; and if a mixed number be propoſed, either reduce it to an improper fraction, or reduce the vulgar fraction to a decimal, and proceed by the rule.

A TABLE OF POWERS.

Roots, - - -	1	1	2	3	4	5	6	7	8	9
Squares, - - -	2	1	4	9	16	25	36	49	64	81
Cubes. - - -	3	1	8	27	64	125	216	343	512	729
Biquadrates, - -	4	1	16	81	256	625	1296	2401	4096	6561
Surſolids, - -	5	1	32	243	1024	3125	7776	16807	32768	59049
Square Cubes, -	6	1	64	729	4096	15625	46656	117649	262144	531441
Second Surſolids, -	7	1	128	2187	16384	78125	279936	823543	2097152	4782969
Biquadrates, Squared ;	8	1	256	6561	65536	390625	1679816	5764801	16777216	43046721
Cubes, Cubed, -	9	1	512	19683	262144	1953125	10077696	40353607	134217728	387420489
Surſolids, Squared ;	10	1	1024	59049	1048576	9765625	60466176	282475249	1073741824	4386784401
Third Surſolids, -	11	1	2048	177147	4194304	48828125	362797056	1977326743	8589934592	31381059609
Square Cubes, Squared;	12	1	4096	531441	16777216	244140625	2176782336	13841287201	68719476736	282429536481

EXAMPLES.

1. What is the 5th power of 9?

$$\begin{array}{r} 9 \\ 9 \\ \hline 81 = \text{2d power.} \\ 9 \\ \hline 729 = \text{3d power.} \\ 9 \\ \hline 6561 = \text{4th power.} \\ 9 \\ \hline 59049 = \text{5th power,} \\ \text{or } Anſ. = 9^5. \end{array}$$

2. What is the 5th power of $\frac{3}{5}$? *Anſ.* $\frac{243}{3125}$.

3. What is the 4th power of ,045?
Anſ. ,000004100625.

Here, we ſee, that in raiſing a fraction to a higher power, we decreaſe its value.

EVOLUTION,

OR THE EXTRACTION OF ROOTS.

The Root is a number whoſe continual multiplication into itſelf produces the power, and is denominated the ſquare, cube, biquadrate, or 2d, 3d, 4th root, &c. accordingly, as it is, when raiſed to the 2d, 3d, 4th, &c. power, equal to that power. Thus, 4 is the ſquare root of 16; becauſe $4 \times 4 = 16$, and 3 is the cube root of 27; becauſe $3 \times 3 \times 3 = 27$; and ſo on.

Although there is no number of which we cannot find any power exactly, yet there are many numbers, of which preciſe roots can never be determined. But by the help of decimals, we can approximate towards the root, to any aſſigned degree of exactneſs.

The roots, which approximate, are called *ſurd roots*; and thoſe which are perfectly accurate, are called *rational roots*.

Roots are ſometimes denoted by writing the character $\sqrt{\ }$ before the power, with the index of the root over it; thus the 3d root of 36 is expreſſed $\sqrt[3]{36}$, and the 2d root of 36 is $\sqrt{36}$, the index 2 being omitted when the ſquare root is deſigned.

If the power be expreſſed by ſeveral numbers, with the ſign + or — between them, a line is drawn from the top of the ſign over all the parts of it; thus,

the 3d root of 47 + 22 is $\sqrt[3]{47+22}$, and the 2d root of 59 — 17 is $\sqrt{59-17}$, &c.

Sometimes roots are deſigned like powers, with fractional indices; thus, the ſquare root of 15 is $15^{\frac{1}{2}}$, the cube root of 21 is $21^{\frac{1}{3}}$, and the 4th root of 37 — 20 is $\overline{37-20}^{\frac{1}{4}}$, &c.

THE EXTRACTION OF THE SQUARE ROOT.

RULE 1. Diſtinguiſh the given number into periods of two figures each, by putting a point over the place of units, another over the place of hundreds, and ſo on, which points ſhow the number of figures the root will conſiſt of.

2. Find the greateſt ſquare number in the firſt, or left hand period, place the root of it at the right hand of the given number, (after the manner of a quotient in diviſion) for the firſt figure of the root, and the ſquare number, under the period, and ſubtract it therefrom, and to the remainder bring down the next period for a dividend.

3. Place the double of the root, already found, on the left hand of the dividend for a diviſor.

4. Seek how often the diviſor is contained in the dividend, (except the right hand figure) and place the anſwer

in the root for the ſecond figure of it, and likewiſe on the right hand of the diviſor: Multiply the diviſor, with the figure laſt annexed, by the figure laſt placed in the root, and ſubtract the product from the dividend: To the remainder join the next period for a new dividend.

5. Double the figure already found in the root, for a new diviſor, (or, bring down your laſt diviſor for a new one, doubling the right hand figure of it) and from theſe, find the next figure in the root as laſt directed; and continue the operation, in the ſame manner, till you have brought down all the periods.

Note 1. If, when the given power is pointed off as the power requires, the left hand period ſhould be deficient, it muſt nevertheleſs ſtand as the firſt period.

Note 2. If there be decimals in the given number, it muſt be pointed both ways from the place of units: If, when there are integers, the firſt period in the decimals be deficient, it may be completed by annexing ſo many cyphers as the power requires: And the root muſt be made to conſiſt of ſo many whole numbers and decimals as there are periods belonging to each; and when the periods belonging to the given number are exhauſted, the operation may be continued at pleaſure by annexing cyphers.

EXAMPLES.

1. Required the ſquare root of 30138696025?

30138696025(173665 the root.
1

1ſt Diviſor=27)201
189

2d Diviſor=343)1238
1029

3d Diviſor=3466)20969
20796

4th Diviſor=347205)1736025
1736025

2. Required the ſquare root of 575,5?

```
 . .  .
 575,50(23,98+root
 4
 ---
43)175
   129
   ----
469)4650
    4221
    -----
4788)42900
     38304
     -----
      4596 remainder.
```

3. What is the ſquare root of 10342656? *Anſ.* 3216.

4. What is the ſquare root of 964,5192360241? *Anſ.* 31,05671.

5. What is the ſquare root of ,0000316969? *Anſ.* ,00563.

Note. When more than half the root is found, the remaining figures of it may be found by diviſion, making uſe of the laſt diviſor, and bringing down ſo many of the *next figures* of the reſolvend, as there were *periods* to come down, when you began the diviſion.

RULES FOR THE SQUARE ROOT OF VULGAR FRACTIONS AND MIXED NUMBERS.

After reducing the fraction to its loweſt terms, for this and all other roots; then,

1. Extract the *root* of the *numerator* for a *new numerator*, and the *root* of the *denominator* for a *new denominator*, which is the beſt method, provided the denominator be a complete power. But if it be not,

2. Multiply the numerator and denominator together; and the root of this product being made the numerator to the denominator of the given fraction, or made the denominator to the numerator of it, will form the fractional part required:—*Or*,

3. Reduce the vulgar fraction to a decimal, and extract its root.

4. Mixed numbers may either be reduced to improper fractions, and extracted by the firſt or ſecond rule;

rule 1; or the vulgar fraction may be reduced to a decimal, then joined to the integer, and the root of the whole extracted.

EXAMPLES.

1. What is the ſquare root of $\frac{144}{15129}$?

By Rule 1.

$\frac{144}{15129}=\frac{16}{1681}$ 16(4 root of the numerator.
16
--

1681(41 root of the denominator.
16
----
81)81 Therefore $\frac{4}{41}$=the root of the given fraction.
81

By Rule 2.

16×1681=26896 and $\surd$ 26896=164. Then,
$\frac{164}{1681}=\frac{16}{164}=\frac{4}{41}$=,09756+

By Rule 3.

1681)16(,0095181439+. And $\surd$,0095181439= ,09756+.

2. What is the ſquare root of $\frac{2793}{8208}$? *Anſ.* $\frac{7}{12}$.

3. What is the ſquare root of $42\frac{1}{4}$? *Anſ.* $6\frac{1}{2}$.

Note. In extracting the ſquare or cube root of any ſurd number, there is always a remainder or fraction left, when the root is found: To find the value of which, the common method is, to annex *pairs* of cyphers to the reſolvend, for the ſquare, and *ternaries* of cyphers to that of the cube, which makes it tedious to diſcover the value of the remainder, eſpecially in the cube. Now this trouble may be ſaved by the following method.

In the ſquare, the quotient is always doubled for a new diviſor: Therefore, when the work is completed, the root doubled is the true diviſor, or denominator* to its own fraction; as, if the root be 12, the denominator will be 24 ; to be placed under the remainder ; which vulgar fraction, or its equivalent decimal, muſt be annexed to the quotient, or root, to complete it.

---

* Theſe denominators give a ſmall matter too much in the ſquare root, and too little in the cube, yet they will be ſufficient in common uſe.

If to the remainder either of the ſquare or cube, cyphers be annexed, and divided by their reſpective denominators, the quotient will produce the decimals belonging to the root.

APPLICATION AND USE OF THE SQUARE ROOT.

PROBLEM I. *To find a mean proportional between two numbers.*

RULE. Multiply the given numbers together, and extract the ſquare root of the product ; which root will be the mean proportional ſought.

EXAMPLES.

What is the mean proportional between 24 and 96 ?

$\sqrt{96 \times 24} = 48$ *Anſ.*

PROBLEM II. *To find the ſide of a* Square *equal in* Area *to any given* Superficies *whatever.*

RULE. Find the *Area*, and the ſquare root is the ſide of the ſquare ſought.

EXAMPLES.

1. If the area of a circle be 184,125 ; what is the ſide of a ſquare equal in area thereto ?

$\sqrt{184,125} = 13,569+$ *Anſ.*

2. If the area of a triangle be 160 ; what is the ſide of a ſquare equal in area thereto ?

$\sqrt{160} = 12,649+$ *Anſ.*

Prob. III. A certain General has an army of 5625 men; pray how many muſt he place in rank and file, to form them into a ſquare?

$\sqrt{5625}=75$ *Anſ.*[*]

Prob. IV. Let 10952 men be ſo formed, as that the number in rank may be double the file.

$$\sqrt{\frac{10952}{2}}=74 \text{ in file, and } 74\times 2=148 \text{ in rank.}$$

Prob. V. If it be required to place 2016 men ſo as that there may be 56 in rank and 36 in file, and to ſtand 4 feet diſtance in rank, and as much in file; how much ground do they ſtand on?

To anſwer this, or any of the kind, uſe the following proportion:—As unity : to the diſtance : : ſo is the number in rank leſs by one : to a fourth number;—next, do the ſame by the file, and multiply the two numbers together, found by the above proportion, and the product will be the anſwer.[†]

As 1 : 4 :: 56—1 : 220. And as 1 : 4 :: 36—1 : 140. Then, 220 × 140 = 30800 ſquare feet, the *Anſ.*

Prob. VI. Suppoſe I would ſet out an orchard of 600 trees, ſo that the length ſhall be to the breadth as 3 to 2, and the diſtance of each tree, one from the other, 7 yards; how many trees muſt it be in length, and how many in breadth; and how many ſquare yards of ground do they ſtand on?

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[*] If you would have the number of men be double, triple, or quadruple, &c. as many in rank as in file; extract the ſquare root of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c. of the given number of men, and that will be the number of men in file, which double, triple, quadruple, &c. and the product will be the number in rank.

[†] The above rule will be found uſeful in planting trees, having the diſtance of ground between each given.

To reſolve any queſtion of this nature; ſay, as the ratio in length : is to the ratio in breadth :: ſo is the number of trees : to a fourth number; whoſe ſquare root is the number in breadth; —— And as the ratio in breadth : is to the ratio in length :: ſo is the number of trees : to a fourth, whoſe root is the number in length.

As 3 : 2 :: 600 : 400. And $\surd$ 400=20=number in breadth.

As 2 : 3 :: 600 : 900. And $\surd$ 900=30=number in length.

As 1 : 7 :: 30—1 : 203. And as 1 : 7 :: 20—1 : to 133. And 203×133=26999 ſquare yards, the *Anſwer.*

Prob. VII. Admit a leaden pipe $\frac{3}{4}$ inch diameter will fill a ciſtern in 3 hours; I demand the diameter of another pipe, which will fill the ſame ciſtern in 1 hour.

Rule. As the given time is to the ſquare of the given diameter, ſo is the required time, to the ſquare of the required diameter. $\frac{3}{4}$=,75; and ,75×,75=,5625: Then, As 3h. : ,5625 :: 1h. : 1,6875 inverſely, and $\surd$1,6875=1,3 inch nearly, *Anſwer.*

Prob. VIII. If a pipe, whoſe diameter is 1,5 inch, fill a ciſtern in 5 hours; in what time will a pipe, whoſe diameter is 3,5 inches fill the ſame?

1,5×1,5=2,25; and 3,5×3,5=12,25: Then, As 2,25 : 5 :: 12,25 : ,91 hour, inverſely,=54 min. 36 ſec. *Anſwer.*

Prob. IX. If a pipe, 6 inches bore, will be 4 hours in running off a certain quantity of water; in what time will 3 pipes, each 4 inches bore, be in diſcharging double the quantity?

6×6=36, 4×4=16, and 16×3=48. Then, as 36 : 4h. :: 48 : 3h. inverſely, and as 1w. : 3h. :: 2w. : 6h. *Anſwer.*

Prob. X. Given the diameter of a circle to make another circle, which ſhall be 2, 3, 4, &c. times greater or leſs than the given circle.

Rule. Square the given diameter, and if the required circle be greater, multiply the ſquare of the diameter by the given proportion, and the root of the product will be the required diameter;—But if the required circle be leſs; divide the ſquare of the diameter by the given proportion, and the root of the quotient will be the diameter required.

There is a circle, whoſe diameter is 4 inches; I demand the diameter of a circle 3 times as large?

$4\times4=16$; and $16\times3=48$; and $\sqrt{48}=6{,}928+$ inches, *Anſwer.*

Prob. XI. To find the diameter of a circle, equal in area to an ellipſis (or oval) whoſe tranſverſe and conjugate diameters are given.*

Rule. Multiply the two diameters of the ellipſis together; and the Square Root of that product will be the diameter of a circle equal to the ellipſis.

Let the tranſverſe diameter of an ellipſis be 48, and the conjugate 36; what is the diameter of an equal circle?

$48\times36=1728$, and $\sqrt{1728}=41{,}569+$ the *Anſwer,*

Prob. XII. Two ſhips ſail from the ſame port; one goes due north 45 leagues, and the other due weſt 76 leagues: How far are they aſunder?

$45\times45=2025$. $76\times76=5776$. Then, $5776\times2025=780$, and, $\sqrt{7801}=88{,}32$ leagues, the *Anſwer.*

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* The tranſverſe and conjugate are the longeſt and ſhorteſt diameters of an ellipſis; they paſs through the centre, and croſs each other at right angles.

EXTRACTION OF THE CUBE ROOT.

A Cube, is any number multiplied by its *ſquare*. To extract the cube root, is to find a number which being multiplied into its ſquare, ſhall produce the given number.

FIRST METHOD.

RULE 1. Separate the given number into periods of three figures each, by putting a point over the unit figure, and every third figure beyond the place of units.

2. Find the greateſt cube in the left hand period, and put its root into the quotient.

3. Subtract the cube, thus found, from the ſaid period, and to the remainder bring down the next period, and call this the *dividend*.

4. Multiply the ſquare of the quotient by 300, calling it the triple ſquare, and the quotient by 30, calling it the triple quotient, and the ſum of theſe call the *diviſor*.

5. Seek how often the diviſor may be had in the dividend, and place the reſult in the quotient.

6. Multiply the triple ſquare by the laſt quotient figure, and write the product under this dividend; multiply the ſquare of the laſt quotient figure by the triple quotient, and place this product under the laſt; under all, ſet the cube of the laſt quotient figure, and call their ſum the *ſubtrahend*.

7. Subtract the ſubtrahend from the dividend, and to the remainder bring down the next period for a new dividend, with which proceed as before, and ſo on till the whole be finiſhed.

Note. The ſame rule muſt be obſerved for continuing the operation, and pointing for decimals, as in the ſquare root.

EXAMPLES.

EXAMPLES.

1. Required the cube root of 436036824287?

436026824287(7583 the root.
343

1ſt Diviſor=14910)93036=1ſt Dividend.

73500
5250
125

78875=1ſt Subtrahend.

2d Diviſor=1687750)14161824=2d Dividend.

13500000
144000
512

13644512=2d Subtrahend.

3d Diviſor=172391940)517312287=3d Dividend.

517107600
204660
27

517312287=3d Subtrahend.

………

The Method of Operation.

7 × 7 × 300 = 14700=1ſt Triple ſquare.
7 × 30 = 210=1ſt Triple quotient.

14910=1ſt Diviſor.

14700 × 5 = 73500
5 × 5 × 210 = 5250
5 × 5 × 5 = 125

78875=1ſt Subtrahend.

Carried over.

Brought over.

$75 \times 75 \times 300 = 1687500$ = 2d Triple ſquare.
$75 \times 30 = 2250$ = 2d Triple quotient.

1689750 = 2d Diviſor.

$1687500 \times 8 = 13500000$
$2250 \times 8 \times 8 = 144000$
$8 \times 8 \times 8 = 512$

13644512 = 2d Subtrahend.

$758 \times 758 \times 300 = 172369200$ = 3d Triple ſquare.
$758 \times 30 = 22740$ = 3d Triple quotient.

172391940 = 3d Diviſor.

$172369200 \times 3 = 517107600$
$22740 \times 3 \times 3 = 204660$
$3 \times 3 \times 3 = 27$

517312287 = 3d Subtrahend.

2. What is the cube root of 34965783 ?
Anſwer 327.

3. What is the cube root of 84,604519 ?
Anſwer 4,39.

4. What is the cube root of ,008649 ?
Anſwer ,2052+.

5. What is the cube root of $\frac{125}{343}$?
Anſwer $\frac{5}{7}$.

To find the true denominator, to be placed under the remainder, after the operation is finiſhed.

In the extraction of the cube root, the quotient is ſaid to be ſquared and tripled for a new diviſor : But is not really ſo, till the triple number of the quotient be added to it ; therefore, when the operation is finiſhed, it is but ſquaring the quotient, or root, then multiplying it by 3, and to that number adding the triple number of the root, when it will become the diviſor, or true denominator to its own fraction, which fraction muſt be annexed to the quotient, to complete the root.

Suppoſe the root to be 12, when ſquared it will be 144, and multiplied by 3, it makes 432, to which add 36, the triple number of the root, and it produces 468 for a denominator.

SECOND METHOD.

RULE 1.—Having pointed the given number into periods of three figures each, find the greateſt cube in the left hand period, ſubtracting it therefrom, and placing its root in the quotient ; to the remainder bring down the next period, and call it the *dividend.*

2. Under this dividend write the triple ſquare of the root, ſo that units in the latter may ſtand under the place of hundreds in the former ; and under the ſaid triple ſquare, write the triple root, removed one place to the right hand, and call the ſum of theſe the *diviſor*.

3. Seek how often the diviſor may be had in the dividend, excluſive of the place of units, and write the reſult in the quotient.

4. Under the diviſor write the product of the triple ſquare of the root by the laſt quotient figure, ſetting down the unit's place of this line, under the place of tens in the diviſor ; under this line, write the product of the triple root by the ſquare of the laſt quotient figure, ſo as to be removed one place beyond the right hand figure of the former ; and, under this line, removed one place forward to the right hand, write down the cube of the laſt quotient figure, and call their ſum the *ſubtrahend.*

5. Subtract the ſubtrahend from the dividend, and to the remainder bring down the next period for a new

dividend, with which proceed as before, and ſo on, till the whole be finiſhed.

EXAMPLE.

Required the Cube root of 16194277?

$1\dot{6}19\dot{4}27\dot{7}$(253 = Root.
8

8194 = Firſt dividend.

12 = Triple ſquare of 2.
6 = Triple of 2.

126 = Firſt diviſor.

60 = Triple ſquare of 2 multiplied by 5.
150 = Triple of 2 multiplied by the ſquare of 5.
125 = Cube of 5.

7625 = Firſt ſubtrahend.

569277 = Second dividend.

1875 = Triple ſquare of 25.
25 = Triple of 75.

18825 = Second diviſor.

5625 = Triple ſquare of 25 multiplied by 3.
675 = Triple of 25 multiplied by ſquare of 3.
27 = Cube of 3.

569277 = Second ſubtrahend.

FIRST METHOD *by* APPROXIMATION.

RULE 1.—Find by trial, a cube near to the given number, and call it the *ſuppoſed* cube.

2. Then, as twice the *ſuppoſed* cube, added to the given number, is to twice the given number, added to the *ſuppoſed* cube, ſo is the root of the *ſuppoſed* cube, to the true root, or an approximation to it.

3. By taking the cube of the root, thus found, for the *ſuppoſed* cube, and repeating the operation, the root will be had to a greater degree of exactneſs.

EXAMPLE.

It is required to find the cube root of 54854153? Let 64000000=*ſuppoſed* cube, whoſe root is 400;

Then 64000000 54854153
2 2

128000000 109708306
54854153 64000000

As 182854153 : 173708306 :: 400
400

182854153)69483321400(379=*root nearly.*

Again, let 54439939=*ſuppoſed* cube, whoſe root is 379.

Then, 54439939 54854153
2 2

108879878 109708306
54854153 54439939

As 163734031 : 164148245 :: 379
379

1477334205
1149037715
492444735

163734031)62212184855)379,958793+=
(*Root correct.*

SECOND

SECOND METHOD *by* APPROXIMATION.

RULE 1.—Divide the reſolvend by three times the aſſumed root, and reſerve the quotient.

2. Subtract one twelfth part of the ſquare of the aſſumed root from the quotient.

3. Extract the ſquare root of the remainder.

4. To this root add one half of the aſſumed root, and the ſum will be the true root, or an approximation to it; —Take this approximation as the aſſumed root, and, by repeating the proceſs, a root farther approximated will be found, which operation may be farther repeated as often as neceſſary, and the root diſcovered to any aſſigned exactneſs.

Note. In order to find the value of the firſt aſſumed root, in this or any other power, divide the reſolvend into periods by beginning at the place of units, and including in each period, ſo many figures as there are units in the exponent of the root; viz. 3 figures in the cube root;—4 for the biquadrate, and ſo on: Then by a table of powers, or otherwiſe, find a figure, which, (being involved to the power whoſe exponent is the ſame with that of the required root) is the neareſt to the value of the firſt period of the reſolvend at the left hand; and to that figure annex ſo many cyphers as there are periods remaining in the integral part of the reſolvend; this figure, with the cyphers annexed, will be the aſſumed root: And it is of no importance whether the figure thus choſen, be, when involved, greater or leſs than the left hand period.

1. What is the cube root of 436036824287?

7000=aſſumed root.

8

21,000)436036824287(20763658,2994

Subtr. 7000 × 7000 ÷ 12 = 4083333,3333

√ 16680324,9661 = 4084,15

Add ½ *the aſſumed root,* = 3500

And it gives the approximated root = 7584,15.

For the ſecond operation, uſe the approximated root as the aſſumed one, and proceed as above.

THIRD METHOD *by* APPROXIMATION.

1. Aſſume the root in the uſual way, then multiply the ſquare of the aſſumed root by 3, and divide the reſolvend by this product; to this quotient add $\frac{2}{3}$ of the aſſumed root, and the ſum will be the true root, or an approximation to it.

2. For each ſucceeding operation let the laſt approximated root be the aſſumed root, and proceeding in this manner, the root may be extracted to any aſſigned exactneſs.

What is the cube root of 7?

Let the aſſumed root be 2. Then $2 \times 2 \times 3 = 12$ the diviſor.

12)7,0(,583, to this add $\frac{2}{3}$ of $2 = 1{,}333$, &c. that is, $583 + 1{,}333 = 1{,}916$ approximated root.

Now aſſume 1,916 for the root, then, by the ſecond proceſs, the root is $\frac{7}{3 \times 1{,}916^{2}} + \frac{2}{3} \times 1{,}916 = 1{,}9126$, &c.

APPLICATION *and* USE *of the* CUBE ROOT.

1. To find *two* mean proportionals between any two given numbers.

RULE 1.—Divide the *greater* by the *leſs*, and extract the cube root of the quotient.

2. Multiply the root, ſo found, by the leaſt of the given numbers, and the product will be the *leaſt*.

3. Multiply this product by the ſame root, and it will give the greateſt.

EXAMPLES.

1. What are the two mean proportionals between 6 and 750?

750÷6=125, and $\sqrt[3]{125}=5$. Then 5×6=30=leaſt, and 30×5=150= greateſt. *Anſ.* 30 and 150.

Proof. As 6 : 30 :: 150 : 750.

2. What are the two mean proportionals between 56 and 19208? *Anſ.* 392 *and* 2744.

Note The ſolid contents of ſimilar figures are in proportion to each other, as the cubes of their ſimilar ſides or diameters.

3. If a bullet 6 inches diameter weigh 32 ℔, What will a bullet of the ſame metal weigh, whoſe diameter is 3 inches?

6×6×6=216. 3×3×3=27. As 216 : 32 ℔ :: 27 : 4 ℔, *Anſ.*

4. If a globe of ſilver of 3 inches diameter, be worth £45, what is the value of another globe of a foot diameter?

3×3×3=27. 12×12×12=1728. As 27 : 45 :: 1728 : £2880 *Anſ.*

The ſide of a cube being given, to find the ſide of that cube which ſhall be double, triple, &c. in quantity to the given cube.

RULE.—Cube your given ſide, and multiply it by the given proportion between the given and required cube, and the cube root of the product will be the ſide ſought.

5. If a cube of ſilver, whoſe ſide is 4 inches, be worth £50, I demand the ſide of a cube of the like ſilver, whoſe value ſhall be 4 times as much.

4×4×4=64, & 64×4=256. $\sqrt[3]{256}=6{,}349+$ *inches, Anſ.*

6. There is a cubical veſſel, whoſe ſide is 2 feet: I demand the ſide of a veſſel, which ſhall contain three times as much?

2×2×2=8, and 8×3=24. $\sqrt[3]{24}=2{,}884=2$ feet, $10\frac{8}{5}$ *inches, Anſ.*

7. The diameter of a buſhel meaſure being $18\frac{1}{2}$ inches, and the height 8 inches; I demand the ſide of a cubic box, which ſhall contain that quantity?

Anſ. 12,908 *inches.*

8. Suppoſe a ſhip of 500 tons has 89 feet keel, 36 feet beam, and is ſixteen feet deep in the hold; What are the dimenſions of a ſhip of 200 tons, of the ſame mould and ſhape?

$89\times 89\times 89=704969=$ cubed keel.

As 500 : 200 :: 704969 : 281987,6 cube of the required keel.

$\sqrt[3]{281987{,}6}=65{,}57$ feet the required keel.

As 89 : 65,57 :: 36 : $26{,}522=26\frac{1}{2}$ feet, beam, nearly.

As 89 : 65,57 :: 16 : 11,7 feet, depth of the hold.

EXTRACTION of the BIQUADRATE ROOT.

RULE.—Extract the ſquare root of the reſolvend, and then, the ſquare root of that root, and you will have the biquadrate root.

What is the biquadrate root of 20736?

```
     . . .                   . .
    20736(144               144(12 root required.
     1                       1
    ---                     ---
 24)107                  22)44
     96                     44
    ---                     --
284)1136
    1136
```

By APPROXIMATION.

METHOD 1.

1. Divide the reſolvend by *ſix* times the ſquare of the aſſumed root, and from the quotient ſubtract $\frac{1}{18}$ part of the ſquare of the aſſumed root.

2. Extract the ſquare root of the remainder.

3. Add $\frac{2}{3}$ of the aſſumed root to the ſquare root, and the ſum will be the true root, or an approximation to it.

4. For every ſucceeding operation (either in this or in the following method) proceed in the ſame manner as in the firſt, each time uſing the laſt approximated root for the aſſumed root.

The biquadrate root of 20736 is required.

Here, 10 *is the aſſumed Root.*

10×10×6=600)20736(34,56

Subtract, 10×10÷18= 5,5555

√ 29,0044=5,38

Add $\frac{2}{3}$ *of* 10=6,66

Approximated root 12,04, *to be made the aſſumed root for the next operation.*

METHOD 2.

Divide the reſolvend by *four* times the cube of the aſſumed root: To the quotient add *three fourths* of the aſſumed root, and the ſum will be the true root, or an approximation to it.

Let the biquadrate of 20736 be required, as before.

The aſſumed root is 10.

10×10×10×4=4000)20736(5,184

Add $\frac{3}{4}$ *of* 10=7,5

Approximated root 12,684, *to be made the aſſumed root for the next operation.*

EXTRACTION *of the* SURSOLID ROOT,
By APPROXIMATION.

A particular RULE.

1. Divide the reſolvend by *five* times the aſſumed root, and to the quotient add *one twentieth* part of the *fourth* power of the ſame root.

2. From the ſquare root of this ſum ſubtract *one fourth* part of the ſquare of the aſſumed root.

3. To the ſquare root of the remainder add *one half* of the aſſumed root, and the ſum is the root required, or an approximation to it.

Note. This Rule will give the root true to *five* places, at the leaſt, (and generally to eight or nine places) at the firſt proceſs.

Required the ſurſolid Root of $2\dot{8}1950\dot{6}2187\dot{5}$?

200=*aſſumed root.*
5
1000) 281950621,875 *quotient.*
Add 200×200×200×200÷20 =80000000

√361950621,875=19025 *nearly.*
Subtract, 200×200÷4=10000

√9025=95
Add half the aſſumed root =100

Root 195 *required.*

A General RULE *for extracting the* ROOTS *of all* POWERS.

RULE * 1.—Prepare the given number, for extraction, by pointing off from the unit's place, as the required root directs.

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* The extracting of roots of very high powers will, by this rule, be a tedious operation :—The following method, when practicable, will be much more convenient.

When the index of the power, whoſe root is to be extracted, is a compoſite number, take any two or more indices, whoſe product is equal to the given index, and extract out of the given number a root anſwering to another of the indices, and ſo on, to the laſt.

Thus, the fourth root=ſquare root of the ſquare root; the ſixth root=ſquare root of the cube root;—the eighth root=ſquare root of the fourth root:—the ninth root=the cube root of the cube root;—the tenth root=ſquare root of the fifth root;—the twelfth root=cube root of the fourth, &c.

2. Find the firſt figure of the root by trial, or by inſpection into the Table of Powers, and ſubtract its power from the left hand period.

3. To the remainder bring down the firſt figure in the next period, and call it the *dividend.*

4. Involve the root to the next inferior power to that which is given, and multiply it by the number, denoting the given power, for a *diviſor.*

5. Find how many times the diviſor may be had in the dividend, and the quotient will be another figure of the root.

6. Involve the whole root to the given power, and ſubtract it from the *given number* as before.

7. Bring down the firſt figure of the next period to the remainder for a new dividend, to which find a new diviſor, as before, and, in like manner, proceed till the whole be finiſhed.

EXAMPLES.

1. What is the cube root of 20346417?

$$20\dot{3}46\dot{4}17(273$$

$2^3 = 8 =$ 1ſt Subtrahend.

$2^2 \times 3 = 12)123 =$ Dividend.

$27^3 = 19683 =$ 2d Subtrahend.

$27^2 \times 3 = 2187)6634 =$ 2d Dividend.

$273^3 = 20346417 =$ 3d Subtrahend.

. . . .

The Method of Operation.

$2 \times 2 \times 2 = 8$ root of the firſt period, or 1ſt ſubtrahend.
$2 \times 2 = 4$ (=next inferior power) and,

4×3 (the index of the given power) = 12, 1ſt diviſ.
27×27×27=19683=2d ſubtrahend.
27×27=229 (next inferior power) and,
729×3(=index of the given power)=2187=2d div.
273×273×273=20346417=3d ſubtrahend.

2. What is the biquadrate root of 34827998976?
Anſ. 431,9+.

OF PROPORTION IN GENERAL.

Numbers are compared together to diſcover the relations they have to each other.

There muſt be two numbers to form a compariſon: The number, which is compared, being written firſt, is called the *antecedent;* and that, to which it is compared, the *conſequent.*

Numbers are compared with each other two different ways: The one compariſon conſiders the *difference* of the two numbers, and is called Arithmetical Relation, the difference being ſometimes named the Arithmetical Ratio; and the other conſiders their *quotient*, which is termed Geometrical Relation, and the quotient, the Geometrical Ratio. Thus, of the numbers 12 and 4; the difference, or Arithmetical Ratio, is 12—4=8; and the Geometrical Ratio is $\frac{12}{4}=3$.*

If two or more, couplets of numbers have equal ratios, or differences, the equality is termed proportion; and their terms ſimilarly poſited, that is, either all the greater, or all the leſs taken as antecedents, and the reſt as conſequents, are called proportionals. So, the two couplets, 2, 4, and 6, 8, taken thus, 2, 4, 6, 8, or thus, 4, 2, 8, 6, are arithmetical proportionals; and the two
couplets,

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* RATIOS are, here, always conſidered as the reſult of the greater term of compariſon diminiſhed, or divided by the leſs; not regarding which of them be the antecedent.

couplets, 2, 4, and 8, 16, taken thus, 2, 4, 8, 16, or thus, 4, 2, 16, 8, are geometrical proportionals.*

Proportion is diſtinguiſhed into continual and diſcontinual. If, of ſeveral couplets of proportionals, written down in a ſeries, the difference or ratio of each conſequent, and the antecedent of the next following couplet, be the ſame as the common difference or ratio of the couplets, the proportion is ſaid to be continual, and the numbers themſelves, a ſeries of continual proportionals, or an arithmetical or geometrical proportion. So 2, 4, 6, 8 form an arithmetical proportion; for $4-2=6-4=8-6=2$; and 2, 4, 8, 16, a geometrical proportion; for $\frac{4}{2}=\frac{8}{4}=\frac{16}{8}=2$.

Note. It is common to read the geometricals $2:4::8:16$: Thus, 2 is to 4 as 8 is to 16, or As 2 to 4 ſo is 8 to 16.

But if the difference or ratio of the conſequent of one couplet, and the antecedent of the next couplet be not the ſame as the common difference or ratio of the couplets, the proportion is ſaid to be diſcontinual. So 4, 2, 8, 6, are in diſcontinued arithmetical proportion; for $4-2=8-6=2=$ common difference of the couplets, $8-2=6=$ difference of the conſequent of one couplet and the antecedent of the next; alſo, 4, 2, 16, 8 are in diſcontinued geometrical proportion: For $\frac{4}{2}=\frac{16}{8}=2=$ common ratio of the couplets, and $\frac{16}{2}=8=$ ratio of the conſequent of one couplet and the antecedent of the next.

ARITHMETICAL

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* Four numbers are ſaid to be *reciprocally* or *inverſely* proportional, when the fourth is leſs than the ſecond, by as many times as the third is greater than the firſt, or when the firſt to the third, is as the fourth to the ſecond, and *vice verſa*. Thus 2, 9, 6 and 3 are reciprocal proportionals.

ARITHMETICAL PROPORTION.

THEOREM 1. If any four quantities, 2, 4, 6, 8, be in Arithmetical Proportion, the ſum of the two means is equal to the ſum of the two extremes.

And if any three quantities, 2, 4, 6, be in Arithmetical Proportion, the double of the mean is equal to the ſum of the extremes.

THEOREM 2. In any continued arithmetical proportion, 1, 3, 5, 7, 9, 11, the ſum of the two extremes, and that of every other two terms, equally diſtant from them, are equal: Thus, $1+11=3+9=5+7$.

When the number of terms is odd, as in the proportion 3, 8, 13, 18, 23, then the ſum of the two extremes being double to the mean, or middle term, the ſum of any other two terms, equally remote from the extremes, muſt likewiſe be double to the mean.

THEOREM 3. In any continued arithmetical proportion, 4, $4+2$, $4+4$, $4+6$, $4+8$, &c. the laſt or greateſt term is equal to the firſt or leaſt more the common difference of the terms drawn into the number of all the terms after the firſt, or into the whole number of the terms, leſs one.

THEOREM 4. The ſum of any rank, or ſeries, of quantities in continued arithmetical proportion, 1, 3, 5, 7, 9, 11, is equal to the ſum of the two extremes multiplied into half the number of terms.*

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* The ſame thing alſo holds, when the number of terms is odd, as in the ſeries 4, 8, 12, 16, 20; for then, the mean, or middle term, being equal to half the ſum of any two terms, equally diſtant from it on contrary ſides, it is obvious that the value of the whole ſeries is the ſame as if every term thereof were equal to the mean, and therefore is equal to the mean (or half the ſum of the two extremes) multiplied by the whole number of terms; or to the ſum of the extremes multiplied by half the number of terms.

The ſum of any number of terms of the arithmetical ſeries of odd numbers, 1, 3, 5, 7, 9, &c. is equal to the ſquare of that number.

ARITHMETICAL PROGRESSION.

Any rank of numbers, more than two, increaſing by a common exceſs, or decreaſing by a common difference, is ſaid to be in Arithmetical Progreſſion.

If the ſucceeding terms of a progreſſion exceed each other, it is called an aſcending ſeries or progreſſion; if the contrary, a deſcending ſeries.

So { 0. 1. 2. 4. 6. 8, &c. is an aſcending arithmetical ſeries.
1. 2. 4. 8. 16. 32, &c. is an aſcending geometrical ſeries.
& { 8. 6. 4. 2. 1. 0, &c is a deſcending arithmetical ſeries.
32. 16. 8. 4. 2. 1, &c. is a deſcending geometrical ſeries.

The numbers which form the ſeries, are called the terms of the progreſſion.

Note. The firſt and laſt terms of a progreſſion are called the extremes, and the other terms the means.

Any three of the five following things being given, the other two may be eaſily found.

1. The firſt term.
2. The laſt term.
3. The number of terms.
4. The common difference.
5. The ſum of all the terms.

PROBLEM I. *The firſt term, the laſt term, and the number of terms being given, to find the common difference.*

RULE.

For, $0+1$ or the ſum of 1 term $=1^2$ or 1
$1+3$ or the ſum of 2 terms $=2^2$ or 4
$4+5$ or the ſum of 3 terms $=3^2$ or 9
$9+7$ or the ſum of 4 terms $=4^2$ or 16
$16+9$ or the ſum of 5 terms $=5^2$ or 25, &c.

Whence, it is plain, that let there be any number whatever, the ſum of its terms will be equal to its ſquare.

EXAMPLE.

The firſt term, the ratio, and number of terms given, to find the ſum of the ſeries.

A Gentleman travelled 29 days; the firſt day he went but 1 mile, and increaſed every day's travel 2 miles: How far did he travel? $29\times29=841$ miles, the *Anſwer.*

Rule. Divide the difference of the extremes by the number of terms leſs 1, and the quotient will be the common difference ſought.

EXAMPLES.

1. The extremes are 3 and 39, and the number of terms is 19; what is the common difference?

$$\left.\begin{array}{r}39\\ -\ 3\end{array}\right\}\text{Extremes.}$$

Divide by the number of terms leſs 1=19—1=18)36(2 *Anſwer.*
36
—

$$\text{Or, }\frac{39-3}{19-1}=2.$$

2. A man had 10 ſons, whoſe ſeveral ages differed alike; the youngeſt was 3 years old, and the eldeſt 48; what was the common difference of their ages?

$$\textit{Anſ. }\frac{48-3}{9-1}=5.$$

3. A man is to travel from Boſton to a certain place in 9 days, and to go but 5 miles the firſt day, increaſing every day by an equal exceſs, ſo that the laſt day's journey may be 37 miles; required the daily increaſe?

$$\frac{37-5}{9-1}=4\text{ the }\textit{Anſ.}$$

Problem 2. *The firſt term, the laſt term, and the number of terms being given, to find the ſum of all the terms.*

Rule. Multiply the ſum of the extremes by the number of terms, and half the product will be the anſwer.

EXAMPLES.

EXAMPLES.

1. The extremes of an arithmetical ſeries are 3 and 39, and the number of terms 19; required the ſum of the ſeries?

$$\left.\begin{array}{r} 39 \\ +\ 3 \end{array}\right\}\text{Extremes.}$$

$$\begin{array}{rr} \text{Sum}= & 42 \\ \text{Number of terms}= & \times\ 19 \\ \hline & 378 \\ & 42 \\ \hline & 2)798 \\ \hline & 399 \end{array}$$

399 the *Anſwer*.

Or, $\frac{\overline{39+3}\times 19}{2}=399$

2. It is required to find how many ſtrokes the hammer of a clock would ſtrike in a week, or 168 hours, provided it increaſed 1 at each hour?

$$\frac{\overline{168+1}\times 168}{2}=14196 \text{ } \textit{Anſ.}$$

3. Suppoſe a number of ſtones were laid a yard diſtant from each other for the ſpace of a mile, and the firſt, a yard from a baſket; what length of ground will that man travel over, who gathers them up ſingly, returning with them one by one to the baſket?

$$\frac{\overline{3520+2}\times 1760}{2}=3099360 \text{ yds.}=1761 \text{ miles, } \textit{Anſ.}$$

N. B. In this queſtion, there being 1760 yards in a mile, and the man returning with each ſtone to the baſket, his h ; t ravel will be doubled, therefore the firſt term will be 2, and the laſt 1760×2, and the number of terms 1760.

4. A man bought 25 yards of linen in Arithmetical Progreſſion; for the 4th yard he gave 12 ſhillings, and for the laſt yard £3 15s. What did the whole amount to, and, what did it average per yard?

$\frac{75-12}{22-1}=3$ the common difference, by which the firſt (term is found to be 3.

Then, $\frac{\overline{75+3}\times 25}{2}=$ £48 15s. and the average price is (£1 19s. per yard.

5. Required the ſum of the firſt 1000 numbers in their natural order?

$$\frac{\overline{1000+1}\times 1000}{2}=500500,\ \textit{Anſ.}$$

Problem 3. *Given the extremes and the common difference, to find the number of terms.*

Rule. Divide the difference of the extremes by the common difference, and the quotient increaſed by 1 will be the number of terms required.

EXAMPLES.

1. The extremes are 3 and 39, and the common difference 2; what is the number of terms?

$$\left.\begin{array}{r}39\\-\ 3\end{array}\right\}\text{Extremes.}$$

Common difference=2)36

Quotient= 18

Add 1

19 the *Anſwer.*

Or, $\frac{39-3}{2}+1=19.$

2. A man, going a journey, travelled the firſt day 7 miles, the laſt day 51 miles, and each day increaſed his journey by 4 miles; how many days did he travel, and, how far?

$\frac{51-7}{4}+1=12$ days, and $\frac{\overline{51+7}\times 12}{2}=348$ miles, *Anſ.*

PROBLEM 4. *The extremes and common difference given, to find the ſum of all the ſeries.*

RULE. Multiply the ſum of the extremes by their difference increaſed by the common difference, and the product divided by twice the common difference, will give the ſum.

EXAMPLES.

1. If the extremes are 3 and 39, and the common difference 2; what is the ſum of the ſeries?

$39+3=42$=Sum of the extremes.
$39-3=36$=Difference of extremes.
$36+2=38$=Difference of extremes increaſed by the (common difference.

$$\begin{array}{r} 42\\ \times 38\\ \hline 336\\ 126\\ \hline \end{array}$$

Twice the common diff. $=4)1596$

399 *the Anſwer.*

$$Or, \frac{\overline{39+3}\times\overline{39-3+2}}{2\times 2}=339$$

2. A owes B a certain ſum, to be diſcharged in a year, by paying 6d. the firſt week, 18d. the ſecond, and thus to increaſe every weekly payment by a

ſhilling, till the laſt payment be £2 11s. 6d.; what is the debt?

$$\frac{\overline{51,5+,5}\times\overline{51,5-,5+1}}{1\times2}=\pounds 67\ 12\text{s. }\textit{Anſ.}$$

PROBLEM 5. *The extremes and the ſum of the ſeries given, to find the common difference.*

RULE. Divide the product of the ſum and difference of the extremes, by the difference of twice the ſum of the ſeries, and the ſum of the extremes, and the quotient will be the common difference.

EXAMPLE.

Let the extremes be 3 and 39, and the ſum 399: what is the common difference?

$$\begin{array}{lr}
\text{Sum of the extremes}=39+3= & 42\\
\text{Diff. of the extremes}=39-3= & \times 36\\
\hline
 & 252\\
 & 126\\
\hline
\overline{399\times2}-42=756) & 1512(2 \text{ the } \textit{Anſ.}\\
 & 1512
\end{array}$$

$$\textit{Or, } \frac{\overline{3+39}\times\overline{39-}}{\overline{399\times2}-\overline{39+3}}=2.$$

PROBLEM 6. *The extremes and ſum of the ſeries given, to find the number of terms.*

RULE. Twice the ſum of the ſeries, divided by the ſum of the extremes, will give the number of terms.

EXAMPLE.

EXAMPLE.

Let the extremes be 3 and 39, and the ſum of the ſeries 399; what is the number of terms?

$$
\begin{array}{rl}
\text{Sum of the ſeries} = & 399 \\
 & \times\ 2 \\
\hline
\text{Sum of the extr.} = 39+3 = 42) & 798(19\ \textit{the Anſ.} \\
 & 42 \\
\hline
 & 378 \\
 & 378 \\
\hline
\end{array}
$$

Or, $\frac{399+2}{39+3}=19.$

GEOMETRICAL PROPORTION.

THEOREM 1. If four quantities, 2, 6, 4, 12, be in geometrical proportion, the product of the two means, 6 × 4, will be equal to that of the two extremes, 2 × 12, whether they are continued or diſcontinued; and, if three quantities, 2, 4, 8, the ſquare of the mean is equal to the product of the two extremes.

THEOREM 2. If four quantities, 2, 6, 4, 12, are ſuch that the product of two of them, 2 × 12, is equal to the product of the other two, 6 × 4, then are thoſe quantities proportional.

THEOREM 3. If four quantities, 2, 6, 4, 12, are proportional, the rectangle of the means, divided by either extreme, will give the other extreme.

THEOREM 4. The products of the correſponding terms of two geometrical proportions are alſo proportional.

That is, if 2 : 6 :: 4 : 12 and 2 : 4 :: 5 : 10; then will 2×2 : 6×4 :: 4×5 : 12×10.*

---

* And if any quantities be proportional, their ſquares, cubes, &c. will likewiſe be proportional.

Theorem 5. If four quantities, 2, 6, 4, 12, are directly proportional.

Then,

1. Directly,	2 : 6 :: 4 : 12
2. Inverſely,	6 : 2 :: 12 : 4
3. Alternately,	2 : 4 :: 6 : 12
4. Compoundly,	2 : 8 :: 4 : 16
5. Dividedly,	2 : 4 :: 4 : 8
6. Mixtly,	8 : 4 :: 16 : 8
7. By Multiplication,	$2r : 6r :: 4 : 12$
8. By Diviſion,	$\frac{2}{r} : \frac{6}{r} :: 4 : 12$

Becauſe the product of the means in each caſe, is equal to that of the extremes, and therefore the quantities are proportional by Theorem 2.

Theorem 6. If three numbers, 2, 4, 8, be in continued proportion, the ſquare of the firſt will be to *that* of the ſecond, as the firſt number to the third; that is, $2 \times 2 : 4 \times 4 :: 2 : 8$.

Theorem 7. In any continued geometrical proportion, (1, 3, 9, 27, 81, &c.) the product of the two extremes, and *that* of every other two terms, equally diſtant from them are equal.

Theorem 8. The ſum of any number of quantities, in continued geometrical proportion, is equal to the difference of the rectangle of the ſecond and laſt terms, and the ſquare of the firſt divided by the difference of the firſt and ſecond terms.

GEOMETRICAL PROGRESSION.

A Geometrical Progreſſion is when a *Rank* or *Series*, of numbers, increaſes, or decreaſes, by the continual multiplication, or diviſion, of ſome equal number.

Problem 1. *Given one of the extremes, the ratio, and the number of the terms of a Geometrical Series to find the other extreme.*

Rule. Multiply, or divide (as the caſe may require) the given extreme by ſuch power of the ratio, whoſe exponent

ponent[*] is equal to the *number* of terms leſs 1, and the product or quotient, will be the other extreme.

EXAMPLES.

1. If the firſt term be 4, the ratio 4, and the number of terms 9; what is the laſt term?

1. 2. 3. 4. + 4 = 8
4. 16. 64. 256. × 256=65536=power of the ratio whoſe exponent is leſs by 1, than the number of terms.

65536=8th power of the ratio.
Multiply by 4=firſt term.

262144=laſt term.
Or, $4 \times 4^8 = 262144$ = *the Anſ.*

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[*] As the laſt term, or any term near the laſt, is very tedious to be found by continual multiplication, it will often be neceſſary, in order to aſcertain them, to have a ſeries of numbers in Arithmetical Proportion, called *Indices* or *Exponents*, beginning either with a cypher or a unit, whoſe common difference is *one.*

When the *firſt* term of the ſeries and the *ratio* are *equal*, the *indices* muſt begin with a unit, and, in this caſe, the product of any two terms is equal to that term ſignified by the *ſum* of their *indices.*

Thus, { 1. 2. 3. 4. 5. 6. &c. Indices Arithmetical ſeries.
{ 2. 4. 8. 16. 32. 64. &c. Geometrical ſeries (leading terms)
Now, 6+6=12=the index of the twelfth term, and
64 × 64=4096=the twelfth term.

But when the *firſt* term of the ſeries and the *ratio* are different, the *indices* muſt begin with a cypher, and the ſum of the *indices*, made choice of, muſt be *one leſs* than the *number of terms* given in the queſtion; becauſe 1 in the *indices* ſtands over the *ſecond term*, and 2 in the *indices* over the third term, &c. And, in this caſe, the *product* of any *two* terms, divided by the *firſt*, is equal to that term *beyond* the firſt, ſignified by the *ſum* of their *indices.*

Thus, { 0. 1. 2. 3. 4. 5. 6, &c. Indices.
{ 1. 3. 9. 27. 81. 243. 729, &c. Geometrical ſeries.
Here, 6 + 5 = 11 the Index of the 12th term.
729 × 243=177147 the 12th term, becauſe the firſt term of the ſeries and the ratio are different, by which mean a cypher ſtands over the firſt term.

Thus, by the help of theſe *indices*, and a few of the firſt terms in any geometrical ſeries, any term, whoſe diſtance from the firſt term is aſſigned, though it were ever ſo remote, may be obtained without producing all the terms.

Note.

2. If the laſt term be 262144, the ratio 4, and the number of terms 9; what is the firſt term?

8th power of the ratio $4^8=65536)262144=$ the firſt term.

Or, $\frac{262144}{4^8}=4$ the firſt term.

Again, Given the firſt term, and the ratio, to find any other term aſſigned.

Rule 1. When the indices begin with a unit.

1. Write down a few of the leading terms of the ſeries, and place their indices over them.

2. Add together ſuch indices, whoſe ſum ſhall make up the entire index to the term required.

3. Multiply the terms of the geometrical ſeries, belonging to thoſe indices, together, and the product will be the term ſought.

1. If the firſt term be 2, and the ratio 2; what is the 13th term?

1. 2. 3. 4. 5 + 5 + 3 = 13
2. 4. 8. 16. 32 × 32 × 8 = 8192 *Anſ.*
Or, $2\times2^{12}=8192$.

2. A merchant wanting to purchaſe a cargo of horſes for the Weſt-Indies, a jockey told him he would take all the trouble and expenſe, upon himſelf, of collecting and purchaſing 30 horſes for the voyage, if he would give him what the laſt horſe would come to by doubling the whole number by a half penny, that is, two farthings for the firſt, four for the ſecond, eight for the third, &c. to which the merchant, thinking he had made a very good bargain, readily agreed: Pray, what did the laſt horſe come

Note. If the *ratio* of any geometrical ſeries be *double*, the *difference* of the *greateſt* and *leaſt* terms is equal to the ſum of all the terms, except the greateſt: If the *ratio* be *triple*, the *difference* is *double* the ſum of all but the greateſt: If the *ratio* be *quadruple*, the difference is *triple* the ſum of all but the greateſt, &c.

In any geometrical ſeries decreaſing, and continued *ad infinitum*, *half* the *greateſt* term is equal to the *ſum* of all the remaining terms, *ad infinitum*.

come to; and, what did the horſes, one with another, coſt the merchant?

[30th, or laſt term.
1. 2. 3. 4. 5. 6+ 6= 12th. 12 + 12 + 6=
2. 4. 8. 16. 32. 64×64=4096 & 4096×4096×64=
1073741824 qrs.=£1118481 1s. 4d. and their average price was £37232 14s. 0½d. a piece.

Rule 2. When the indices begin with a cypher.

1. Write down a few of the leading terms of the ſeries, as before, and place their indices over them.

2. Add together the moſt convenient indices to make an Index, leſs by 1 than the number expreſſing the price of the term ſought.

3. Multiply the terms of the geometrical ſeries, together, belonging to thoſe indices, and make the product a dividend.

4. Raiſe the firſt term to a power, whoſe Index is one leſs than the number of terms multiplied, and make the reſult a diviſor, by which, divide the dividend, and the quotient will be that term beyond the firſt, ſignified by the ſum of thoſe indices, or the term ſought.

3. If the firſt term be 5, and the ratio 3, what is the 7th term?

0. 1. 2. 3+ 2+ 1= 6=Ind. to the term
(beyond 1ſt, or 7th.
5. 15. 45. 135×45×15=91125=Dividend.

The number of terms, multiplied, is 3 (viz. 135×45×15) and 3−1=2, is the power to which the term 5 is to be raiſed; but the 2d power of 5 is 5×5=25, and therefore 91125÷25=3645 the 7th term required.

Prob. 2. *Given the firſt term, the ratio, and number of terms, to find the ſum of the ſeries.*

Rule. Raiſe the ratio to a power, whoſe Index ſhall be equal to the number of terms, from which ſubtract 1; divide the remainder by the ratio, leſs

1, and the quotient, multiplied by the firſt term, will give the ſum of the ſeries.

EXAMPLES.

1. If the firſt term be 5, the ratio 3, and the number of terms 7; what is the ſum of the ſeries?

Ratio=3 × 3 × 3 × 3 × 3 × 3 × 3=2187=7th power
Subtract 1 (of the ratio;

Divide by the ratio leſs 1=3—1=2)2186

Quotient = 1093
Multiply by the firſt term = 5

Sum of the ſeries = 5465

Or, $\frac{3^7-1}{3-1}\times 5=5465$ *Anſ.*

2. A ſhopkeeper ſold 13 yards of cloth, on the following terms, viz. 2d. for the firſt yard, 4d. for the ſecond, 8d. for the third, &c.; I demand the price of the cloth.

$\frac{2^{13}-1}{2-1}\times 2=16382$d.=£68 5s. 2d. *Anſwer.*

3. A gentleman, whoſe daughter was married on a new year's day, gave her a guinea, promiſing to triple it on the firſt day of each month in the year; pray what did her portion amount to?

$\frac{3-1}{3-1}\times 1=265120$ guineas, *Anſwer.*

4. What debt can be diſcharged in a year, by paying 1 ſhilling the firſt month, 10s. the ſecond, and ſo on, each month in a tenfold proportion?

$10^{12}-1\div 10-1\times 1=111111111111$ ſhillings,= £5555555555 11s. *Anſwer.*

5. A man threſhed wheat 9 days for a farmer, and agreed to receive but 8 wheat corns for the firſt day's work, 64 for the ſecond, and ſo on in an eight-fold proportion; I demand what his 9 days' labour amounted to, rating the wheat at 5s. per buſhel ?*

Anſ. $\frac{82-1}{8-1}\times 8=153391688$ corns. *Amount*=£78 0s. 5½d.

6. An ignorant fop, wanting to purchaſe an elegant houſe; a facetious gentleman told him he had one which he would ſell him on theſe moderate terms, viz. that he ſhould give him a penny for the firſt door, 2d. for the ſecond, 4d. for the third, and ſo on, doubling at every door, which were 36 in all: It is a bargain, cried the ſimpleton, and here is a guinea to bind it; pray what would the houſe have coſt him?

Anſ. $\frac{2^{36}-1}{2-1}\times 1=68719476735$d.=£286331153 1s. 3d.

7. A young fellow, well ſkilled in numbers, agreed with a rich farmer to ſerve him 10 years, without any other reward, but the produce of one wheat corn for the firſt year, and that produce to be ſowed from year to year, till the end of the time, allowing the increaſe but in a tenfold proportion; what is the ſum of the whole produce? and, what will it amount to, at 5s. per buſhel?

Anſ. $\frac{10^{10}-1}{10-1}\times 10=11111111110$ corns. *Amount*=£5651 8s. $0\frac{9}{10}$d.

8. Suppoſe one farthing had been put out at 6 per cent. per annum, compound intereſt,† at the commence-

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* *Note,* 7680 wheat or barley corns are ſuppoſed to make a pint.

† Any ſum, at £6 per cent. per annum, compound intereſt, will double in eleven years and three hundred and twenty-five days, or 11,889 years, or 11,89 is near enough; then, if you divide 1784 by 11,89, it will give the number of terms in this caſe equal to 150;—The ratio will be 2, and the firſt term 1.

ment of the Chriſtian Æra; what would it have amounted to in 1784 years? and ſuppoſe the amount to be in ſtandard gold, allowing a cubic inch to be worth £53 2s. 8d. how large would the maſs have been?

Anſ. $\frac{2^{150}-1}{2-1}\times 1=$ £1486716346568748209435714 5
(5150989076706536 1 11s. $3\frac{3}{4}$d.
= 2798085972212123041597957123293359421076 6 cubic inch-
(es of gold.

As, 355 : 113 :: 360 × 69,5 : 7964 Earth's diameter.
360 × 69.5 × 7964 × 1327,33 = 264482820122 cubic miles in the globe = 6727333730885474136883 2000 cub. inches in the globe. Then, 2798085972212123041597957123293359421076 6 ÷ 6727333730885474136883 2000 = 415930899840288,8 which, however incredible it may appear to ſome, is more than four hundred and fifteen millions of millions, nine hundred and thirty thouſand, eight hundred and ninety-nine millions, eight hundred and forty thouſand, two hundred and eighty-eight times larger than the globe we inhabit.

PROBLEM 3. *The firſt term, the laſt term (or the extremes) and the ratio given, to find the ſum of the ſeries.*

RULE. Divide the difference of the extremes by the ratio leſs by 1: Add the greater extreme to the quotient, and the reſult will be the ſum of all the terms.

Or, multiply the greateſt term by the ratio, from the product ſubtract the leaſt term; then divide the remainder by the ratio, leſs by 1, and the quotient will be the ſum of all the terms.

Or, when all the terms are given, then, from the product of the ſecond and laſt terms ſubtract the ſquare of the firſt term; this remainder being divided by the ſecond term leſs the firſt, will give the ſum of the ſeries.

EXAMPLES.

1. If the ſeries be 2. 6. 18. 54. 162. 486. 1458. 4374; what is its ſum total?

Firſt Method.

From the greateſt term=4374
Subtract the leaſt=2

Divide by the ratio, leſs 1=3—1=2)4372 diff. of ext.

Quotient=2186
Add the greater extreme=4374

6560

Or, $\frac{4374-2}{3-1}+4374=6560$ *Anſ.*

Second Method.

Greateſt term=4374
Multiply by the ratio= 3

Product=13122
Subtract the leaſt term= 2

Divide by the ratio, leſs by 1×3—1=2)13120

Anſ. 6560

Or, $\frac{\overline{4374\times3}-2}{3-1}=6560$

Third Method.

Greateſt term= 4374
Multiply by the ſecond term= 6

Product=26244
Subtract the ſquare of the firſt term=2×2= 4

Div. the rem. by the 2d term leſs the 1ſt=6—2=4)26240

Anſ. 6560

Or, $\frac{\overline{4374\times6}-4}{6-2}=6560$

2. A man travelled 6 days; the firſt day he went 4 miles, and each day doubling his day's travel, his laſt day's ride was 128 miles; how far did he go in the whole?

$$\frac{128-4}{2-1}+128=252$$ miles, *Anſwer.*

3. A gentleman dying, left 5 ſons; to whom he bequeathed his eſtate as follows, viz. to his youngeſt ſon £1000; to the eldeſt £5062 10s. and ordered that each ſon ſhould exceed the next younger by the equal ratio of $1\frac{1}{2}$; what did the ſeveral legacies amount to?

$$\frac{5062,5-1000}{1,5-1}+5062,5=$$ £13187 10s. *Anſ.*

Problem 4. *Given the extremes and ratio, to find the number of terms.*

Rule. Divide the greateſt term by the leaſt; find what power of the ratio is equal to the quotient; then, add 1 to the index of that power, and the ſum will be the number of terms.

Or, Subtract the logarithm* of the leaſt term from *that* of the greateſt; divide the remainder by the logarithm of the ratio, and add 1 to the quotient.

EXAMPLE.

If the leaſt term be 2, the greateſt term 4374, and the ratio 3, what is the number of terms?

Divide by the leaſt term=2)4374=greateſt term.

3×3×3×3×3×3×3 = Quo. 2187=7th power, then 7+1=8 the *Anſwer.*

---

* Logarithms are artificial numbers, the addition of which anſwers to multiplication of whole numbers, and ſubtraction to diviſion.

Or,

From the logarithm of the greateſt term = 3.64088

Subtract the logarithm of the leaſt term = 0.30103

Divide the remainder by the logarithm of the ratio } =,47712)3.33985(7+1=8 *Anſ.*

3.33984

1

Problem 5. *Given the leaſt term, the ratio, and the ſum of the ſeries, to find the laſt term.*

Rule. Multiply the ſum of the ſeries by the ratio, leſs 1; to that product add the firſt term, and the reſult, divided by the ratio, will give the laſt term.

E X A M P L E.

If the firſt term be 2, the ratio 3, and the ſum of the ſeries 6560; what is the laſt term?

$$\frac{\overline{3-1}\times 6560+2}{3}=4374 \text{ Anſwer.}$$

SIMPLE INTEREST.

Intereſt is a premium allowed by the borrower of any ſum of money to the lender, according to a certain rate per cent agreed on, which by law is ſtated at £6, that is, 6 for the uſe of £100 for one year.

Principal is the money lent.

Rate is the ſum per cent. agreed on.

Amount is the principal and intereſt added together.

Intereſt is of two ſorts, *ſimple* and *compound.*

Simple intereſt is that, which is allowed for the principal lent only.

Note. The rules for ſimple intereſt ſerve alſo to calculate commiſſion, brokerage, inſurance, purchaſing ſtocks, or any thing elſe rated at ſo much per cent.

General

General Rule.

1. Multiply the principal by the rate, and divide the product by 100 (or, which is the ſame, cut off the two right hand figures in the pounds, which muſt be reduced to the loweſt denomination, each time cutting off as at firſt) and the quotient will be the anſwer for one year.

2. For more years than one, multiply the intereſt of one year by the given number of years, and the product will be the anſwer for that time.

3. If there be parts of a year, as months, or days, work for the months by the aliquot parts of a year, and for the days, by the Rule of Three Direct, or (which is ſufficiently exact for common uſe, allowing 30 days to the month) take aliquot parts of the ſame.

Note, when the rate per cent. per annum, is	£.	multiply the principal by		of the given number of months, cutting off, as before directed, and you will have the intereſt for the given time.
	9		$\frac{3}{4}$	
	8		$\frac{2}{3}$	
	6		$\frac{1}{2}$	
	4		$\frac{1}{3}$	
	3		$\frac{1}{4}$	
	2		$\frac{1}{6}$	

Examples.

1. What is the intereſt of £573 13 9½ for one year, at 6 per cent. per annum?

£.	s.	d.
573	13	9½
		6
34|42	2	9
20		
8|42		
12		
5|13		
4		
0|52		

Anſ. £34 8 5.

2. What is the intereſt of £329 17 6½ for 3 years, 7 months and 12 days, at £5 per cent. per annum?

£.	s.	d.
329	17	6½
		5
16|49	7	8½
20		
9|87		
12		
10|52		
4		
2|10		

Then,

6 months	½	16	9	10½	intereſt of 1 year
				3	
		49	9	7½	ditto of 3 years
1 month	⅙	8	4	11¼	ditto of 6 months
10 days	⅓	1	7	5¾	ditto of 1 month
2 days.	⅕		9	1¾	ditto of 10 days
			1	9¾	ditto of 2 days
					Y. m. d.
		£59	13		ditto of 3 7 12

Or thus:

		£.	s.	d.
£5	$\frac{1}{20}$	329	17	6½
6 months	½	16	9	10½
				3
		49	9	7½
1 ditto	⅙	8	4	11¼
10 days	⅓	1	7	5¾
2 days	⅕		9	1¾
			1	9¾
		£59	13	*Anſ.*

3. What is the intereſt of £439 12 9½ at £6 per cent. per annum, for 16 months?

£. s. d.
439 12 9½
8=½ the number of months.

Anſ. £35|17 2 4
20
s. 3|42
12
d. 5|08

4. What is the intereſt of £591 15 9¼ for 15 months, at £8 per cent. per annum?

£591 15 9¼
10=⅔ the number of months.

£59|17 17 8½
20
s. 3|57
12
d. 6|92
4
qrs. 3|70

5. What is the intereſt of £347 7 5½ at £4 per cent. per annum, for 15 months?

£347 7 5½
5=⅓ the number of months.

£17|36 17 3½
20
s. 7|37
12
d. 4|47
4
qr. 1|90

6. What is the intereſt of £517 15 4 for one month, at £6 per cent per annum?
Anſ. £2 11 9¼

7. Of £457 12 8½ for 2 months, at 6 per cent. per annum?
Anſ. £4 11 6¼

8. Of £347 5 9 for 3 months, at £6 per cent. per annum?
Anſ. £5 4 2

9. Of £397 19 for 4 months, at £6 per cent. per annum?
Anſ. £7 19 2

10. £508 10 5½ for 5 months, at £6 per cent. per annum?
Anſ. £12 14 3¼

11. £719 19 4 for 6 months, at £6 per cent. per annum?
Anſ. 21 11 11¾

12. £396 5 10 for 7 months, at £6 per cent. per annum?
Anſ. £13 17 4¾

13. £517 11 11½ for 8 months, at £6 per cent. per annum?
Anſ. £20 14 0¾

14. £245 5 8¾ for 9 months, at £6 per cent. per annum?
Anſ. £11 0 9

15. £195 15 5½ for 10 months, at £6 per cent. per annum?
Anſ. £9 15 9¼

16. £148 12 6½ for 11 months, at £6 per cent. per annum?
Anſ. £8 3 5¾

17. £509 9 2 for 13 months, at £6 per cent. per annum?
Anſ. £33 2 3½

18. £317 17 8½ for 14 months, at £6 per cent. per annum?
Anſ. £22 5 0¼

19. £443 10 3 for 15 months, at £6 per cent per annum?
Anſ. £33 5 3

20. £293 7 9 for 16 months, at £6 per cent. per annum?
Anſ. £23 9 5

21. £333 13 3¾ for 17 months, at £6 per cent. per. annum?
Anſ. £28 7 2¾

22. £517 6 6 for 18 months, at £6 per cent. per annum?
Anſ. £46 11 2

23. £347 11 7½ for 19 months, at £6 per cent per annum?
Anſ. 33 0 4¾

24. £419 12 5 for 20 months, at £6 per cent. per annum?
Anſ. £41 19 2¾

25.

25. £537 13 5½ for 16 months, at £9 per cent. per annum? *Anſ.* £64 10 4¾

26. £1 for 1 year, at 6 per cent. per annum? *Anſ.* 1s. 2d. 1$\frac{6}{10}$qr.

SIMPLE INTEREST BY DECIMALS.

A TABLE of RATIOS, from *one* pound, &c. to *ſeven* pounds.

Rate per Cent	*Ratios*	*Rate per Cent*	*Ratios*	*Rate per Cent*	*Ratios*
1	,01	3	,03	5	,05
1¼	,0125	3¼	,0325	5¼	,0525
1½	,015	3½	,035	5½	,055
1¾	,0175	3¾	,0375	5¾	,0575
2	,02	4	,04	6	,06
2¼	,0225	4¼	,0425	6¼	,0625
2½	,025	4½	,045	6½	,065
2¾	,0275	4¾	,0475	6¾	,0675

Ratio is the ſimple intereſt of £1 for 1 year, at the rate per cent. agreed on.

A TABLE *for the ready finding of the decimal parts of a year, equal to any number of* days *or* quarter *of a* year,

Days	*Decimal pts.*	*D.*	*Decimal pts.*	*Days*	*Decimal pts.*
1	,00274	10	,027397	100	,273973
2	,005479	20	,054794	200	,547945
3	,008219	30	,082192	300	,821918
4	,010959	40	,109589	365	1,000000
5	,013699	50	,136986	¼ *of a year* =	,25
6	,016438	60	,164383	½ *of a year* =	,5
7	,019178	70	,191781	¾ *of a year* =	,75
8	,021918	80	,219178		
9	,024657	90	,246575		

CASE I.

The principal, time and ratio are given, to find the intereſt, and amount.

RULE. Multiply the principal, time and ratio continually together, and the laſt product will be the intereſt, commiſſion, brokerage, &c. to which add the principal, and the ſum will be the amount.

EXAMPLES.

1. Required the amount of £537 10s. at £6 per cent. per annum, for 5 years?

Principal 537,5
Multiply, by the ratio=,06

Product 32,250
Multiply by the time= 5

Intereſt =161,250
Add the principal=537,5

Amount=£698,75
20

15,00 *Anſ.* £698 15s.

Or, 537,5×,06×5+537,5=£698 15s.

2. What is the ſimple intereſt of £917 16s. at £5 per cent per annum, for 7 years?

Anſ. £321 4s. 7d.

3. What is the amount of £235 3s. 9d. at £5¼ per cent. per annum, from March 5th, 1794, to November 23d, 1794?

Anſ. £244 0s. 8½d.

4. If my correſpondent is to have £2½ per cent. what will his commiſſion on £785 15s. amount to?

Anſ. £19 12s. 10½d.

5. If a broker diſpoſes of a cargo for me, to the amount of £637 10s. on commiſſion at £1¼ per cent. and procures me another cargo of the value of £817 15s. on commiſſion at £1¼ per cent.; what will his commiſſion, on both cargoes, amount to?

Anſ. £22 5s. 7d.

CASE II.

The amount, time and ratio given, to find the principal.

Rule. Multiply the ratio by the time; add unity to the product for a diviſor, by which ſum divide the amount, and the quotient will be the principal.

EXAMPLES.

1. What principal will amount to £1045 14s. in 7 years, at £6 per cent. per annum?

Ratio=,06
Multiply by the time= 7
Product=,42
Add 1
Diviſor=1,42)1045,7(736,4084+=
(£736 8s. 2d.

2. What principal will amount to £3810 in 6 years, at £4½ per cent. per annum? *Anſ.* £3000.

3. What principal will amount to £666 9s. 0¼d. in 3½ years, at £5¼ per cent. per annum? *Anſ.* £563.

CASE III.

The amount, principal and time given, to find the ratio.

Rule. Subtract the principal from the amount; divide the remainder by the product of the time and principal, and the quotient will be the ratio.

EXAMPLES.

1. At what rate per cent. will £543 amount to £705 18s. in 5 years?

From the amount=705,9
Take the principal=543

Divide by 543×5=2715)162,90(,06=£6 *Anſ.*
162,90

2. At what rate per cent. will £391 17s. amount to £449 3s. 1¾,74qr. in 3¼ years? *Anſ.* £4½.

3. At what rate per cent. will £413 12s. 6d. amount to £546 3s. 8d. in 4¾ years? *Anſ.* £6¾.

CASE IV.

The amount, principal and rate per cent. given, to find the time.

Rule. Subtract the principal from the amount; divide the remainder by the product of the ratio and principal; and the quotient will be the time.

EXAMPLES.

1. In what time will £543 amount to £705 18s. at £6 per cent. per annum?

From the amount=705,9
Take the principal=543

Divide by 543×,06=32,58)162,9(5 years, *Anſ.*
162,9

2. In what time will £3000 amount to £3810 at 4½ per cent. per annum? *Anſ.* 6 years.

To find the Intereſt of any ſum, at 6 per cent. per annum, for any number of months.

Rule. If the months be an even number, multiply the principal by half that number: And if the months be uneven, halve the even months, to which annex $\frac{5}{10}$; thus, the half of 19 is 9,5, and multiply the principal as before, cutting off two figures more at the right hand, than there are decimals in both factors, which reduce to farthings, each time cutting off as at firſt.

3. What is the intereſt of £345 16s. 6d. for 9 years and 11 months, at 6 per cent. per annum?

Y. M.
9 11
12

2)119 months.

345,825   59,5 = ½ No. of months.
59,5

1729125
3112425
1729125

£205,765875 = £205 15 3¾ *Anſ.*
Principal = £345 16 6

Amount = £551 11 9¾.

A Table *of Decimal parts for every day in the twelfth part of a year, which conſiſts of 365¼ days.*

days.	dec. pts	days.	dec. pts	days.	dec. pts.	days.	dec. pts.	days.	dec. pts
1	,033	7	,23	13	,427	19	,624	25	,821
2	,066	8	,263	14	,46	20	,657	26	,854
3	,098	9	,296	15	,493	21	,69	27	,887
4	,131	10	,328	16	,526	22	,723	28	,92
5	,164	11	,361	17	,558	23	,756	29	,953
6	,197	12	,394	18	,591	24	,788	30	,986

Note. This table may alſo be uſed for the parts of a year, in compound intereſt, after having worked for whole years.

To find the Intereſt of any ſum, either for months, or months and days, at 6 per cent. per annum.

Rule. Multiply the principal by the number of months (and parts, if any, anſwering to the given number of days in the table) and cut off one figure at the right hand of the product more than is required by the rule in decimals, and the product will be the intereſt for the given time in ſhillings and decimal parts of a ſhilling.

What is the intereſt of £250 10s. for 19 months and 7 days ?

Principal=£250,5
Time=19,23

7515
5010
22545
2505

Anſ. s. 481,7115
=£24 1s. 8½d.

Another Method of calculating Intereſt for Months, at £6 per cent per annum.

Rule. If the principal conſiſt of pounds only, cut off the unit figure, and, as it then ſtands, it will be the intereſt for one month in ſhillings and decimal parts : If it conſiſt of pounds, ſhillings, &c. reduce the ſhillings, &c. to decimals, which, with the unit figure of the pounds, will be decimal parts of a ſhilling.

EXAMPLES.

1. What is the intereſt of £175 for 5 months ?

£175=17,5 ſhillings= intereſt for 1 month.

17,5
Mult. by the time= 5

2|0|87,5

Anſ.=£4 7s. 6d.

2. What is the intereſt of £255 16s. for 7 months ?

Shill.
£255 16=25,58 int. for
7 (1 mon.

2|0|179,06

£8 19s. 0½d.

SIMPLE INTEREST IN FEDERAL MONEY.

PROB. 1. *When the principal is given in lawful money, and the intereſt is required in federal money, at 6 per cent. per annum.*

RULE. Reduce the ſhillings, &c. to their equivalent decimal, by inſpection, divide the whole by 5, and the quotient is the annual intereſt: Or, multiply the principal by 2, and the product (having the unit figure of the pounds cut off) will be the intereſt as before.

EXAMPLES.

1. Required the annual intereſt of £517 3s. 7½d. at 6 per cent.?

3s.=,15 5)517,181 *Dols. c. m.*
1½d.= 30 103,436=103,43,6 *Anſ.*
Exceſs of 12= 1
—— *Or,* 517,181
,181 2
—————— *Dols. c. m.*
103,4362=103,43,6$\frac{2}{10}$

2. Required the annual intereſt of £1 in dollars?

5)1,00
20 cents, *Anſwer.*

PROB. 2. *When the principal is given in lawful money, and the intereſt and amount are required in federal money, at 6 per cent.*

RULE. Reduce the lawful money to federal, then divide the principal by 20, and that quotient by 5; add thoſe quotients together, and they are the intereſt; or, add them to the principal, and their ſum is the amount.

EXAMPLES.

1. Required the amount of £425 16s. 8½d. for one year, at 6 per cent.?

,8	3)425,835
34	
1	20)1419,450
	5)70,9725
,835	14,1945
	Dols. c. m.
	1504,6170=1504,61,7 *Anſ.*

2. Required the amount of £112 4s. 6d. for 1 year

,2	3)112,225
24	
1	20)374,083
	5)18,7041
,225	3,7408
	Dols. c. m.
	396,52,79=396,52,7,9 *Anſ.*

Prob. 3. *When the principal is lawful money, and the monthly intereſt is required in federal money.*

Rule. Reduce the ſhillings, &c. to decimals, by inſpection, then ſeparate the right hand figure of the pounds with the decimals, divide by 6, and the quotient is the anſwer in dollars, cents, &c.

EXAMPLE.

Required the monthly intereſt of £425 16s. 8½d. in federal money?

8	
34	6)42,5835 *Dols. c. m.*
1	7,09725=7,09,7¼ *Anſ.*
835	

Prob. 4. *When the principal is federal money, and the intereſt is required in the ſame.*

Rule. Work according to the general rule in ſimple intereſt, that is, multiply by the rate of intereſt, ſeparate the two right hand figures of the dollars in the product, and it will give the intereſt in dollars, cents. &c.

N. B. The figures, which are more than three places to the right hand of the comma, are of no account.

EXAMPLES.

1. What is the annual intereſt of 537*D.* 24*c.* 6*m.* at 6 per cent. ?

```
*D. c. m.*
537,24,6
       6
———————     D. c. m.
32,23476=32,23,4 Anſ.
```

2. What is the intereſt of 1465*D.* 46*c.* 6*m.* for 16 months, at 6 per cent. per annum ?

```
D. c. m.
1465,46,6
         8=half the number of months.
—————————     D. c. m.
117,23728=117,23,7 Anſ.
```

3. What is the intereſt of 537*D.* 34*c.* 7*m.* for 19 months, at 6 per cent. per annum ?

```
 D. c. m.
 537,34,7
      9,5=half the number of months.
 ————————
 2686735
4836123
————————.—    D. c. m.
51,047965=51,04,7 Anſ.
```

N. B. Becauſe there are 4 decimals in the multiplicand and multiplier, I cut off 4 figures for them, and two more according to the rule.

PROB. 5. *When the principal is federal money, and the monthly intereſt is required in the ſame, at 6 per cent. per annum.*

RULE. Separate the two right hand figures of the dollars, and you then have the intereſt of 2 months; half of which is the monthly intereſt in dollars, cents, &c. If there is but one place, or figure, of dollars, a cypher muſt be prefixed to the left hand.

EXAMPLES.

1. What is the monthly intereſt of 9*D.* 59*c.* 7*m.* at 6 per cent. per annum?

2),09597   *c. m.*
,047985=4,8 nearly, *Anſ.*

2. What is the monthly intereſt of 100*D.* 50*c.* 5*m.*?

2)1,00505   *c. m.*
,50252=50,2½ *Anſ.*

Rules for calculating Intereſt for Days.

RULE 1. Multiply the given principal by the given number of days, and that product by the rate on the pound; divide the laſt product by 365, and it will give the intereſt.

EXAMPLE.

What is the intereſt of £360 10s. for 175 days, at 6 per cent.?

$\frac{360,5\times175\times,06}{365}$=£10,37=£10 7s. 4¾d. *Anſ.*

RULE 2. Multiply the given principal by the given number of days, and divide the product by 6083, for £6 per cent. the number of days in which any ſum will double, at that rate, the quotient will give the anſwer.

EXAMPLE.

What is the intereſt £ of 327 10s. at 6 per cent. per annum, for 210 days?

$$\frac{327,5 \times 210}{6083} = £11,306 = £11\ 6s.\ \textit{Anſ.}$$

Rule for making a Diviſor for any rate per cent.

Multiply 365 by 100, and divide the product by the rate.

Thus, for 6 per cent. $\frac{365 \times 100}{6} = 6083$ diviſor.

For 5 per cent. $\frac{365 \times 100}{5} = 7300$ diviſor, &c.

Hence, when intereſt is to be calculated on caſh accounts, accounts current, or any other accounts, where partial payments are made, or partial debts are contracted; multiply the ſeveral balances into the days they are at intereſt, and the ſum of theſe products, divided as above, will give the intereſt at £5 or £6 per cent. and for any other rate, make the proper addition or deduction: or find a diviſor, as before directed.

EXAMPLE.

On the 1ſt of January I lent £450 10 6, which I received back in the following partial payments, viz. on the 15th of January, £57 11 9; on the 7th of February, 39 3 10; on the 19th of March, 63 5 2; on the 4th of April, 45; on the 26th of April, 19 12 6; on the 12th of May, 100; on the 10th of June, 60 7 3; and on the firſt of Auguſt, £65 10; what intereſt is due at 6 per cent.?

Dates.

Dates.						Days.	Products.		
			£.	s.	d.		£.	s.	d.
Jan.	1	Lent on demand	450	10	6	14	6307	7	0
	15	Received in part	57	11	9				
		Balance	392	18	9	24	9430	10	
Feb.	7	Received in part	39	3	10				
		Balance	353	14	11	40	14149	16	8
Mar.	19	Received in part	63	5	2				
		Balance	290	9	9	16	4647	16	
April	4	Received in part	45	0	0				
		Balance	245	9	9	22	5400	14	6
Ditto	26	Received in part	19	12	6				
		Balance	225	17	3	16	3613	16	
May	12	Received in part	100	0	0				
		Balance	125	17	3	29	3650	0	3
June	10	Received in part	60	7	3				
		Balance	65	10	0	52	3406	0	0
Aug.	1	Receiv'd in full of the principal	65	10					
							50 606		0

£. s. d.
6083)50606 0 5(8 6 4½ *Anſ.*

I have given Peter Truſty a caſh credit for £1000, in conſequence of which, on the 12th of May, I paid his bill for £250; ditto 27th paid his draught for £280; June 1ſt he gave me a bill on the Maſſachuſetts bank, at ſight, for £290; July the 17th he paid me per receipt £70; Auguſt 20th he drew for £750 at ſight; ditto 31ſt he paid me per receipt, £500; September 15th he drew at ſight for £135; and 3d of October for £175; October 29th he paid me per receipt, £250; and November 3d £125; November 12th he drew at ſight for £375, and ditto 18th for £125; January 1ſt he paid me per receipt £290, and 20th ditto £210; on the 1ſt of March following, he demands a ſettlement; what is then due to me, intereſt at 6 per cent.

Dates.			£.	*Days.*	*Products.*
May	12	Paid his bill - -	250	15	3750
Ditto	27	Paid his draught	280		
		Balance	530	5	2650
June	1	Received in part	290		
		Balance	240	46	11040
July	17	Received in part	70		
		Balance	170	34	5780
Auguſt	20	Paid - - - - - - -	750		
		Balance	920	11	10120
Ditto	31	Received in part	500		
		Balance	420	15	6300
September	15	Paid - - - - - -	135		
		Balance	555	18	9990
October	3	Paid - - - - - - -	175		
		Balance	730	62	18980
Ditto	29	Received in part	250		
		Balance	485	5	2400
November	3	Received in part	120		
		Balance	355	9	3195
Ditto	12	Paid - - - - - -	375		
		Balance	730	6	4380
Ditto	18	Paid - - - - - -	125		
		Balance	855	62	53010
January	1	Received in part	290		
		Balance	565	19	10735
Ditto	20	Received in part	210		
March	1	*Balance*	355	40	14200
					£165530

Then,

73|00)1565|30

5)21 8 10 Int. at £5 per cent. per annum
4 5 10 add.

25 14 8 Int. at 6 per cent. on ſaid account.
355 Balance of the account.

£380 14 8 Total balance in my favour.

When caſh credits are given, a balance ſhould be made upon every tranſaction, which ſhould be multiplied into the days, the firſt leiſure minute; then when the time of ſettlement comes, you will only have to add up the products, and divide as above, and the account will be finiſhed.

A owes B the following ſums, with the intereſt on them, at 6 per cent. per annum, as follows, viz. £60 for 7 months; £150 for 5 months; £75 10s. for 9 months; £145 15s. for 7 months, and £397 12s. for 4½ months; what is the amount of principal and intereſt?

£. *Months.*
60 × 7 = 420
150 × 5 = 750
75,5 × 9 = 679,5
145,75 × 7 = 1020,25
397,6 × 4,5 = 1789,2

200)4648,95
23,24 intereſt.
828,85 principal.

Amount, *Anſ.* £852,09

Note. I divide by 200, the number of months, in which any ſum will double at 6 per cent. per annum, and it gives the intereſt.

When partial payments are made upon notes, bonds, &c. at any interval greater than a year, the intereſt is calculated in a progreſſive manner, by adding the intereſt to the principal at the time of the firſt payment, and from the ſum deducting the payment, &c.

DISCOUNT

Is an allowance made for the payment of any ſum of money, before it becomes due, and is the difference between that ſum, due ſome time hence, and its preſent worth.

The preſent worth of any ſum, or debt, due ſome time hence, is ſuch a ſum, as, if put to intereſt, would in that time and at the rate per cent. for which the diſcount is to be made, amount to the ſum or debt, then due.

Rule. As the amount of £100, for the given rate and time, is to £100: So is the given ſum or debt, to the preſent worth.

Subtract the preſent worth from the given ſum, and the remainder will be the diſcount required.

Or,

As the amount of £100 for the given rate and time, is to the intereſt of £100 for that time: So is the given ſum or debt to the diſcount required.

EXAMPLES.

1. What is the diſcount of £635 17s. due two years hence, at 5½ per cent. per annum?

Int. of £100 per annum } £. s. 5 10
2 years.

11
Add 100 £. £. s.

As £111 : 11 :: 635 17
20 20

2220 12717
11

12717
12717

222|0)13988|7(£63 diſcount.
1332

668
666

27
20

222|0)540(0
12

222|0)648|0(2
444

204 *Anſ.* £63 0 2¾d.

Or, as 111 : 100 :: 635 17 : 572 16 9¼ *preſent worth.*

And 635 17—572 16 9¼=63 0 2¾ *diſcount.*

2. What is the preſent worth of £350, payable in half a year, diſcounting at £6 per cent per annum ?

Anſ. £339 16 1¼.

3. What is the preſent worth of £65 due 15 months hence, at £6 per cent per annum ?

Anſ. £60 9 3¼.

4. What is the diſcount on £97 10s. due January 22d, this being September 7th, reckoning intereſt at £5 per cent. ? *Anſ.* £1 15 11.

5. Bought a quantity of goods for £250 ready money, and ſold them for £300, payable in 9 months ; what was the gain, in ready money, ſuppoſing the diſcount to be made at £6 per cent. ?

Anſ. £37 1 7½.

BARTER

Is the exchanging of one commodity for another, and teaches traders to proportion their quantities without loſs.

CASE I.

When the quantity of one commodity is given, with its value, or that of its integer, that is of 1 lb. 1 Cwt. 1 yd. &c. as alſo the value of the integer of ſome other commodity to be given for it, to find the quantity of this ; or, having the quantity thereof given, to find the rate of ſelling it.

Rule. Find the value of the given quantity by the conciſeſt method, then find what quantity of the other, at the rate propoſed, you may have for the ſame money : Or, if the quantity be given, find from thence the rate of ſelling it.

EXAMPLES.

1. How much tea, at 9/6 per lb. muſt be given in barter for 156 gallons of wine, at 12s. 3½d. per gallon ?

| 3d. | 1/4 | 156 gallons.
| 1/2 | 1/2 | 12

1872
39
6 6

1917 6
9/6=114d. 12

23010

d. lb. d.
As 114 : 1 :: 23010
1

114)23010(201
228

210
114

96
16

576
96

114)1536(13 34/114 *Anſ.* 201lb. 13 34/114 oz.
114

396
342

54

2. How much cloth, at 15s. 8d. per yard, muſt be given for 5 Cwt. 8 qrs. 19lb. of ſteel, at 5 guineas per Cwt. ?

Anſ. 50 yds. 3 qrs. 2 nails.

3. Suppoſe A has 350 yards of linen at 1s. 4d. per yard, which he would truck with B for ſugar, at 25s. 6d. per Cwt.; how much ſugar will the linen come to ?

	Cwt.	qr.	lb.
Anſ.	18	1	$5\frac{2}{3}$.

4. A has broadcloth, at £12 10s. per piece, and B has mace, at 8s. per lb.; how many pounds of mace muſt B give A for 35 pieces of cloth? *Anſ.* $1093\frac{3}{4}$lb.

5. A has $7\frac{1}{2}$ Cwt. of ſugar, at 8d. per lb. for which B gave him $12\frac{1}{2}$ Cwt. of flour; what was the flour rated at per lb.? *Anſ.* $4\frac{3}{4}$d.

CASE II.

If the quantities of two commodities be given, and the rate of ſelling them, to find, in caſe of inequality, how much of ſome other commodity muſt be given.

Rule. Find the ſeparate values of the two given commodities; ſubtract the leſs from the greater, and the difference will be the amount of the third commodity, whoſe quantity and rate may be eaſily found.

EXAMPLES.

1. Two merchants barter; A has 30 Cwt. of cheeſe, at 23s. 6d. per Cwt. and B has 4 pieces of broadcloth, at £3 15s. per piece; which muſt receive money? and how much? *Anſ.* B muſt pay A £1 10s.

2. A and B would barter; A has 150 buſhels of wheat at 5s. 9d. per buſhel; for which B gives 65 buſhels of barley, worth 2s. 10d. per buſhel, and the balance in oats, at 2s. 1d. per buſhel; what quantity of oats muſt A receive from B? *Anſ.* $325\frac{3}{5}$ buſhels.

CASE III.

Sometimes, in bartering, one commodity is rated above the ready money price; then, to find the bartering price of the other, ſay, As the ready money price of the one is to its bartering price, ſo is that of the other, to its bartering price: Next find the quantity required, according to either the bartering or ready money price.

EXAMPLES.

1. A has ribbands at 2s. per yard ready money; but in barter he will have 2s. 3d. B has broadcloth at 32s. 6d. per yard ready money: At what rate muſt B value his cloth per yard, to be equivalent to A's bartering price? and how many yards of ribband, at 2s. 3d. per yard, muſt then be given by A for 488 yards of B's broadcloth?

Anſ. B's broadcloth at £1 16s. 6½d. per yard—7930 yards of ribband.

2. A and B barter; A has 150 gallons of brandy at 7s. 3d. per gallon ready money; but in barter he will have 8s. per gallon: B has linen at 3s. 6d. per yard ready money; how muſt B ſell his linen per yard, in proportion to A's bartering price? and how many yards are equal to A's brandy?

Anſ. Barter price is 3s. 10¼d. and he muſt give A 311 yds. 3qr. 3n.

3. P and Q barter; P has linen at 3s. 7d. per yard; but in barter will have 3s. 10d. Q delivers him broadcloth at £1 16s. 6d. per yard, worth only £1 13s. per yard; pray, which has the advantage in barter? and how much linen does P give Q for 148 yards of broadcloth?

Yd. Yds. s.
As 1 : 36/6 :: 148 : 5402 price of the broadcloth. As 3/10 : 1yd. :: 5402s. : $1409\frac{5}{23}$yds. of linen.—Q has the advantage; for, as 3/7 : 3/10 :: 33s. : $35/3\frac{27}{43}$ his proportional price.

4. A has 200 yards of linen, at 1s. 6d. ready money per yard, which he barters with B, at 1s. 9d. per yard, taking buttons at 7½d. per groſs, which are worth but 6d; how many groſs of buttons will pay for the

linen? who gets the beſt bargain, and by how much, both in the whole and per cent.?

Yd. d. Yds. d. d. Groſs. d. Groſs.
As 1 : 21 :: 200 : 4200. As 7½ : 1 :: 4200 : 560.
Yd. d. Yds. £.
As 1 : 18 :: 200 : 15 value of A's linen.
Gr. d. Gr. £.
As 2 : 6 :: 560 : 14 value of B's goods. So that B gained £1 of A.
£. £. £. £.
As 14 : 1 :: 100 : 7 2s. 10d. per cent.

LOSS AND GAIN

Is an excellent Rule, by which merchants and traders diſcover their profit, or loſs, per cent. or by the groſs: It alſo inſtructs them to raiſe or fall the price of their goods, ſo as to gain or loſe ſo much per cent. &c.

CASE I.

To know what is gained or loſt per cent.

Rule. Firſt ſee what the gain or loſs is, by Subtraction; then, As the price it coſt, is to the gain or loſs; ſo is £100 to the gain or loſs per cent.

Examples.

1. If I buy ſerge at 5s. per yard, and ſell it again, at 5s. 8d. per yard; what do I gain per cent. or in laying out £100?

	s.	d.
Sold for	5	8
Coſt	5	0

[See proceſs next page.]

8d. gain per yard.

N. B. The firſt queſtions in the ſeveral Caſes, ſerve to elucidate each other,

d. d. £.
As 60 : 8 :: 100
8
60)800(13
60
200
180
20
20
60)400(6
360
40
12
60)480(8
480

Anſ. £13 6/8.

2. If I buy ſerge at 5/8 per yard, and ſell it again at 5s. per yard ; what do I loſe per cent. or in laying out £100 ?

s. d. d. d. £. £. s. d.
Coſt 5 8 As 68 : 8 :: 100 : 11 15 3½ } (*Anſ.*
ſold for 5 0

8d. Loſs per yard.

3. If I buy a Cwt. of tobacco for £9 6/8, and ſell it again at 1s. 10d. per lb. do I gain or loſe ? and what per cent. ?

	£.	s.	d.
Sold for	10	5	4
Coſt	9	6	8
	£0	18	8 gained in the groſs.

| 2d. | $\frac{1}{12}$ | £. s.
11 4 value at 2s. per lb.
0 18 8 value at 2d per lb.
10 5 4 value at 1s. 10d. per lb.

£. s. d. s. d. £. £.
As 9 6 8 : 18 8 :: 100 : 10 *Anſ.* £10 per cent.

4. A draper bought 60 yards of cloth at 28s. per yard, and 38 yards of ditto, at 14s. per yard, and ſold them one with another, at 26s. per yard; did he gain or loſe? and what per cent.?

yd. s. £. yds. yd. s. yds. £. s.
As 1 : 28 :: 60 : 84 As 1 : 26 :: 98 : 127 8
yd. s. yds. £. s. £. s.
As 1 : 14 :: 38 : 26 12 Sold for 127 8
Prime coſt 110 12
Whole prime coſt £110 12
Gain in the groſs 16 16
£. s. £. s. £. £. s. d.
As 110 12 : 16 16 :: 100 : 15 3 9½ per cent.

5. Bought ſugar at 6½d. per lb. and ſold it at £2 3s. 9d. per Cwt.; what was the gain or loſs per cent.?

lb. lb.
As 1 : 6½d. :: 112 : £3 0s. 8d.
Prime coſt £3 0 8 per Cwt. £. s. d. s. d. £. £. s. d.
Sold at 2 3 9 per Cwt. As 3 0 8 : 16 11 :: 100 : 27 17 8¼
(Loſs per cent. *Anſ.*
Loſt £0 16 11 in the whole.

6. At 2½d. in the ſhilling profit; how much per cent.?

s. d. £. £. s. d.
As 1 : 2½ :: 100 : 20 16 8 *Anſ.*

7 At 4s. 6d. in the pound profit; how much per cent.?

£. s. d. £. £. s.
As 1 : 4 6 :: 100 : 22 10 *Anſ.*

8. If I buy candles, at 1s. 6d. per lb. and ſell them again, at 2s. per lb. and allow 3 months for payment; what do I gain per cent.?

d. d. £. £. s. d.
As 18 : 24 :: 100 : 133 6 8; then, by Diſ-
Mo. £. *Mo.* £ s.
As 12 : 6 :: 3 : 1 10
£. s. £. s. £. s. d. £. s. d.
Then, as 101 10 : 1 10 :: 133 6 8 : 1 19 4½, which taken from £133 6s. 8d. leaves £131 7s. 3½d. therefore, *Anſ.* £31 7s. 3½d.

9. If I buy cloth at 13s. per yard, on 8 months credit, and ſell it again at 12s. ready money, do I gain or loſe? and what per cent.?

Mo. £. *Mo.* £. £. s. £. s. d.
As 12 : 6 :: 8 : 4. As 104 : 13 :: 100 : 12 6

So that 13s. on 8 months credit, at £6 per cent. is equal to 12s. 6d. ready money; then,

s. d.
Prime coſt 12 6 ready money
Sold at 12 0 ready money
Loſt 0 6 in the yard.

s. d. d. £. £.
As 12 6 : 6 :: 100 : 4
Anſ. loſt £4.

In caſting up the amount of goods bought, imported or exported; to the prime coſt of ſuch goods we muſt add all the charges upon them, in order to fix the price they ſtand us in.

10. Suppoſe I import from France 12 bales of cloth, each bale containing 10 pieces, which, with the charges there, amounted to £108; I pay duty here 5s. 6d. per piece, for freight £3 10s. and the porterage 7s. 6d.; what does it ſtand me in per piece? and how muſt I ſell it per piece to gain £10 per cent.?

12 bales.
Each 10 pieces.
In all 120 pieces, at 5s. 6d.

	£.		
Firſt coſt	108	0	0
Duty	33	0	0
Freight	3	10	0
Porterage	0	7	6
Whole coſt	£144	17	6

Pieces. £. s. d. piece.
As 120 : 144 17 6 :: 1
1

0 { 12 } 144 17 6 divisor,
{ 10 } 12 1 5½
£1 4 1¾

£. £. £. s. d.
As 10|0 : 1|0 :: 1 4 1¾
10)1 4 1¾ coſt per piece.
2 5 gain per piece. } at 10 per cent.
£1 6s. 6¾d.

Anſ. { Prime coſt per piece, £1 4 1¾
{ And I muſt ſell it at £1 6 6¾ per piece.

CASE

CASE II.

To know how a commodity muſt be ſold, to gain or loſe ſo much per cent.

Rule. As £100 is to the price; ſo is £100 with the profit added or loſs ſubtracted, to the gaining or loſing price.

EXAMPLES.

1. If I buy a quantity of ſerge, at 5s. per yard; how muſt I ſell it per yard to gain £13 6s. 8d. per cent.?

£. s. £. s. d.
As 100 : 5 :: 113 6 8
20 20
2000 2266
12 12
24000 27200
5
24000)136,000(5
120
16
12
24,000)192,000(8
192
000

Or thus,
£. s. d.
113 6 8
5
s. 5|66 13 4
12
792
Add 8=$\frac{2}{3}$ of 12=13s. 4d.
d. 8|00
s. d.
Anſ. 5 8 per yard.

2. If a barrel of powder coſt £4 how muſt it be ſold to loſe 10 per cent.?

As

Or thus,

£. £. £. £. s.
As 100 : 4 : : 90 : 3 12 *Anſ.*

90
4
£3,60
20
s. 12,00

3. Bought cloth, at 15s. per yard, which not proving ſo good as I expected, I am content to loſe £17$\frac{1}{2}$ per cent. by it; how muſt I ſell it per yard?

£. s. £. s. d.
As 100 : 15 : : 82$\frac{1}{2}$: 12 4$\frac{1}{2}$ *Anſ.* 12s. 4$\frac{1}{2}$d.

4. If 120lb. of ſteel coſt £7; how muſt I ſell it per lb. to gain £15$\frac{1}{2}$ per cent.?

lb. £. lb. s. d. £. s. d. £ s. d.
As 120 : 7 : : 1 : 1 2 As 100 : 1 2 : : 115$\frac{1}{2}$: 1 4
(per lb. *Anſ.*

5. Bought fiſh in Newburyport, at 10s. per quintal, and ſold it at Philadelphia at 17s. 6d. per quintal; now, allowing the charges to be 2s. 6d. per quintal, and conſidering I muſt looſe 20l. per cent. by remitting my money home; what do I gain per cent.?

s. d.
Selling price 17 6 Philadelphia currency per quintal.
Charges = 2 6 Ditto.

15 0 Ditto.

£. s. £. s.
As 100 : 15 : : 80 : 12 New-England currency.
Sold at 12s. per quintal.
Bought at 10s. per. quintal.

s. s. £. £.
Gained 2s. per quintal — As 10 : 2 : : 100 : 20 per
(cent. gained, *Anſ.*

6. Bought 50 gallons of brandy, at 4s. per gallon, but, by accident, 10 gallons leaked out; at

what rate muſt I ſell the remainder per gallon, to gain upon the whole prime coſt, at the rate of £10 per cent.?

50 gall. at 4s. per gall.=£10
10 gallons leaked out.
—
40 gallons remain

Gal. £. Gal. s.
As 40 : 10 :: 1 : 5
£. s. £. s. d.
As 100 : 5 :: 110 : 5 6 *Anſ.*

C A S E III.

When there is gained or loſt per cent. To know what the commodity coſt.

Rule. As £100, with the gain per cent. added, or loſs per cent. ſubtracted, is to the price; ſo is £100 to the prime coſt.

Examples.

1. If 1 yard of cloth be ſold, at 5s. 8d. and there is gained £13 6 8 per cent.; what did the yard coſt?

£. s. d. s. d. £.
As 113 6 8 : 5 8 :: 100
20 12 68
2266 68 800
12 600
27200 272,00)68|00(0
20
272,00)1360|00(5s. prime coſt, *Anſ.*
1360

2. If 12 yards of cloth are ſold at 15s. per yard, and there is £7 10s. loſs per cent. in the ſale; what is the prime coſt of the whole?

Yd. s. Yds. £. £. s. £. £. £. s. d.
As 1 : 15 :: 12 : 9. As 92 10 : 9 :: 100 : 9 13 6
(*Anſ.*

3. If 19½ Cwt. ſugar be ſold, at £4 5s. per Cwt. and I gain £15 per cent. ; what did it coſt per Cwt. ?

£. £. s. £. £. s. d.
As 115 : 4 5 :: 100 : 3 13 10¾ *Anſ.*

C A S E IV.

If by wares ſold at ſuch a rate, there is ſo much gained or loſt per cent. To know what would be gained or loſt per cent. if ſold at another rate.

Rule. As the firſt price is to £100, with the profit per cent. added, or loſs per cent. ſubtracted ; ſo is the other price, to the gain or loſs per cent. at the other rate.

N. B. If your anſwer exceed £100, the exceſs is your gain per cent. but if it be leſs than £100, that deficiency is the loſs per cent.

E X A M P L E S.

1. If cloth, ſold at 5s. 8d. per yard, be £13 6s. 8d. profit per cent. ; what gain or loſs per cent. ſhall I have, if I ſell the ſame at 5s. per yard ?

s. d. £. s. d. s.
As 5 8 : 113 6 8 :: 5
12 20
68 2266
12
27200
5
2,0
68)136000(200,0 100—100=0 *Anſ. I neither gain nor loſe.*
136
£100
,000

2. If cloth, ſold at 4s. per yard, be £10 per cent. profit; what ſhall I gain or loſe per cent. if ſold at 3s. 6d. per yard?

s. £. s. d. £.
As 4 : 110 :: 3 6 : 96¼d. £. £. £.
Then, 100—96¼=3¾ per cent. loſs,
(*Anſ.*

3. I ſold a watch for £50, and by ſo doing, loſt £17 per cent. whereas I ought, in trading, to have cleared £20 per cent; how much was it ſold under its real value?

£. £. £. £. s. d. £. £. s. d.
As 83 : 50 :: 100 : 60 4 9¾ As 100 : 60 4 9¾ ::
£. £. s. d. £. s. d. £. £. s. d.
120 : 72 5 9¼ then, 72 5 9¼—50=22 5 9¼ *Anſ.*

EQUATION OF PAYMENTS

Is the finding of a time to pay at once, ſeveral debts due at different times, ſo that no loſs ſhall be ſuſtained by either party.

Rule 1.* Multiply each payment by the time at which it is due; then divide the ſum of the products by the ſum of the payments, and the quotient will be the equated time, or that required.

EXAMPLES.

1. A owes B £380, to be paid as follows, viz. £100 in 6 months, £120 in 7 months, and £160 in 10 months; what is the equated time for the payment of the whole debt?

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* This rule is founded upon a ſuppoſition, that the ſum of the intereſts of the ſeveral debts, which are payable before the equated time, from their terms to that time, ought to be equal to the ſum of the intereſts of the debts payable after the equated time, from that time to their terms.

$$\begin{array}{r}
100 \times 6 = 600 \\
120 \times 7 = 840 \\
160 \times 10 = 1600 \\
\hline
\end{array}$$

$100+120+160=380)3040(8$ months, *Anſ.*

$$\begin{array}{r}
3040 \\
\hline
\end{array}$$

2. A owes B £104 15s. to be paid in $4\frac{1}{2}$ months, £161 to be paid in $3\frac{1}{2}$ months, and £152 5s. to be paid in 5 months; what is the equated time for the payment of the whole? *Anſ.* 4 months and 8 days.

3. There is owing to a merchant £698, to be paid £178 ready money, £200 at 3 months, and £320 in 8 months; I demand the indifferent time for the payment of the whole? *Anſ.* $4\frac{1}{2}$ months.

4. The ſum of £49 1s. 6d. is to be paid, $\frac{1}{2}$ at 6 months, $\frac{1}{3}$ at 8 months, and $\frac{1}{6}$ at 10 months; what is the mean time for the payment of the whole? *Anſ.* $7\frac{2}{3}$ months.

Rule 2. See by Rule 1ſt, at what time the firſt man, mentioned, ought to pay in his whole money; then, as his money is to its time, ſo is the other's money to his time inverſely, which, when found, muſt be added to, or ſubtracted from, the time at which the ſecond ought to have paid in his money, as the caſe may require, and the ſum, or remainder, will be the true time of the ſecond's payment.

EXAMPLES.

1. A is indebted to B £150, to be paid £50 at 4 months, and £100 at 8 months: B owes A £250, to be paid at 10 months: It is agreed between them, that A ſhall make preſent pay of his whole debt, and that B ſhall pay his ſo much the ſooner, as to balance that favour; I demand the time at which B muſt pay the £250, reckoning ſimple intereſt?

$50 \times 4 = 200$
$100 \times 8 = 800$

$50 + 100 = 15|0)\,100|0(6\frac{2}{3}$ months, A's equated time.
90
10

£. mo. £. mo. mo. mo. mo.
As $150 : 6\frac{2}{3} :: 250 : 4$ then $10 - 4 = 6$ time of B's (payment.

2. A merchant has £1200 due to him, to be paid $\frac{1}{6}$ at 2 months, $\frac{1}{3}$ at 3 months, and the reſt at 6 months; but the debtor agrees to pay $\frac{1}{3}$ down; how long may the debtor detain the other half, ſo that neither party may ſuſtain loſs?

mo. mo.
$\frac{1}{6} \times 2 = 0\frac{1}{3}$
$\frac{1}{3} \times 3 = 1$
$\frac{1}{2} \times 6 = 3$
Equated time $4\frac{1}{3}$

Now, as $\frac{1}{2}$ was paid $4\frac{1}{3}$ months before it was due, it is reaſonable that he ſhould detain the other $\frac{1}{2}$ $4\frac{1}{3}$ months after it became due, which, added, gives $8\frac{2}{3}$ months, the true time for the ſecond payment.

COMMISSION OR FACTORAGE*

Is an allowance of ſo much per cent. to a factor, or correſpondent abroad, for buying and ſelling goods, for his employer.

EXAMPLES.

1. What comes the commiſſion on £539 12/9 to, at $4\frac{1}{2}$ per cent.?

539

---

* The method of working queſtions in this Rule, Brokerage and the firſt caſe of Inſurance, is the ſame as in Simple Intereſt.

£. s. d.
539 12 9
4½

2158 11 0
Product of ½ = 269 16 4½

£24|28 7 4½
20

s. 5|67
12

d. 8|08

2. My factor receives £1008 to lay out after having deducted his commiſſion of £5 per cent.; what does his commiſſion amount to?

Here, as his commiſſion is to be deducted from the given ſum, it is evident that I ought not to pay him commiſſion on his own money (which, however, is often unjuſtly practiſed) therefore,

£. £. £. £.
As 105 : 5 :: 1008 : 48 *Anſ.*

3. My correſpondent writes me that he has purchaſed goods to the value of £673 12s.; what does his commiſſion on that ſum amount to, at £3½ per cent.?

Anſ. £23 11 6.

BROKERAGE

Is an allowance of ſo much per cent. to a perſon called a Broker, for aſſiſting merchants or factors in purchaſing or ſelling goods.

EXAMPLES.

1. What is the brokerage upon £525 10s. at 5s. or £¼ per cent.?

		£.	s.	d.
5s.	¼	525	10	
		1,31	7	6
		20		
		6,27		
		12		
		3,30		
		4		
		1,20		

5 ſhillings being an aliquot part of £1, divide by that part, and the quotient is the anſwer.

Anſ. £1 6 3¼.

2. What is the brokerage upon £673 16s. at £⅝ per cent.? *Anſ.* £4 4 2½.

3. If a broker ſell goods to the amount of £709 19s. 11d.; what is his demand, at £1½ per cent.? *Anſ.* £10 12 11¾.

BUYING AND SELLING STOCKS.

Stock is a general name for the capitals of trading companies, banks, &c. and the buying and ſelling certain ſums of money in thoſe funds, is not unuſual.

EXAMPLES.

1. What is the purchaſe of £275 15s. bank ſtock, at £74½ per cent.?

£74½ want £25½ of £100, therefore, take parts for the deficiency, and ſubtract the ſum of thoſe parts from the given ſum.

			£.	s.	
	£20	⅕	275	15	0
	£5	¼	55	3	0
	£½	$\frac{1}{10}$	13	15	9
			1	7	6¾
Subtract			70	6	3¾
Anſ.			£205	8	8¼

Or, If I had taken parts for £74½, the rate per cent. then the ſum of the ſeveral quotients would have been the anſwer as above.

When the price is above 100, take parts for the ſurplus of the price above 100, and add them to the given ſum for the anſwer.

2. What is the purchaſe of £1029 10s. 6d. bank ſtock, at £110¼ per cent.?

£.		£.	s.	d.	
10	$\frac{1}{10}$	1029	10	6	at 100 per cent.
£¼	$\frac{1}{40}$	102	19	0½	at 10 per cent.
		2	11	5½	at ¼ per cent.
	Anſ.	£1135	1	0	at £110¼ per cent.

3. What does £1600 capital ſtock in the Maſſachuſetts bank come to, at £120⅛ per cent.?

Anſ. £1922.

POLICIES OF INSURANCE.

Inſurance is a ſecurity or aſſurance, by means of a Writ called a Policy, to indemnify the inſured of ſuch loſſes as ſhall be ſpecified in the policy ſubſcribed by the inſurer or inſurers, by which the underwriters oblige themſelves to make good and effectual the property inſured, in conſideration of a certain premium at a ſtipulated rate per cent. (which varies according to the riſk) to be immediately paid down, or otherwiſe ſecured according to the tenor of the agreement.

The average loſs is 10 per cent.—that is, if the inſured ſuffer any damage or loſs, not exceeding 10 per cent. he bears it himſelf, and the inſurers are free.

A policy ſhould be taken out for a ſum ſufficient to cover the principal and premium, and the buſineſs of this rule is, in general, to calculate what that ſum ſhould be.

CASE I.

When the premium, at a certain rate per cent. for inſuring a ſum, is required, the operation is the ſame as in intereſt, or commiſſion.

1. What is the premium upon £537 15 9 at 6½ per cent.?

```
      £.   s.   d.
      537  15   9
                6½
      -------------
     3226  14   6
  ½=268  17  10½
  ---------------
   34|95  12   4½
      20
      --
   19|12
      12
      --
    1|48
       4
      --
    1|94     Anſ. £34 19/1¼.
```

CASE II.

To find the ſum for which a policy ſhould be taken out to cover a given ſum.

Rule. Take the premium from £100, and ſay, as the remainder is to 100; ſo is the ſum adventured to the policy.*

---

* Now, it is plain that, if I want to recover £92, I muſt, in this caſe, inſure upon £100; therefore, to recover £759 I muſt inſure upon £825, for when 8 per cent. for premium is deducted, I ſhall have £759 remaining neat.

For £825=Sum inſured upon at 8 per cent,
      66=Premium to be deducted.
     —
£759=The firſt outſet.

1. It is required to cover £759, premium 8 per cent.; for what ſum muſt the policy be taken?

100
8

92 : 100 :: 759
100

92)75900(£825 *Anſ.*
736

230
184

460
460

2. A merchant ſent a veſſel and cargo to ſea, valued at £1525; what ſum muſt the policy be taken out for, to cover his property, premium 19½ per cent.?

100
19,5

80,5 : 100 :: 1525 : £1894 8 2¼ *Anſ.*

CASE III.

When a policy is taken out for a certain ſum in order to cover a given ſum: To find the premium, ſay; As the policy is to the covered ſum; ſo is £100 to a fourth number, which, being taken from 100, will leave the premium.

If a policy be taken out for £1250 to cover £500; what is the premium per cent.?

1250 : 500 :: 100
100

1250)50000(40 and £100—40=£60 *Anſ.*

CASE IV.

When the policy for covering any ſum and the premium per cent. are given, to find the ſum to be covered.

Rule. Deduct the premium per cent. from 100, and ſay, As 100 is to the remainder; ſo is the policy to the ſum required to be covered.

If a policy be taken out for £1250 at 60 per cent.; what is the adventure, or ſum to be covered?

```
        100
         60
        ---
  100 : 40 :: 1250
                40
           -------
        100)50000(£500 Anſ.
```

COMPOUND INTEREST.

Compound Intereſt is that which ariſes from the intereſt being added to the principal, and (continuing in the hands of the borrower) becomes a part of the principal, at the end of each ſtated time of payment.

General Rule. Find the *amount* of the given principal, for the time of the firſt payment, by ſimple intereſt; next, find the intereſt of that ſum, or principal, and add it as before, and thus proceed for any number of years, ſtill accounting the laſt *amount* as the principal for the next payment. The given principal being ſubtracted from the laſt *amount*, the remainder will be the compound intereſt.

EXAMPLES.

1. What will £480 amount to in 3 years, at £6 per cent. per annum?

Principal, 480
Rate of int. 6
£28|80
20
s. 16|00
Prin. 1ſt year, 480
Int. of ditto, 28 16
Prin. 2d year, 508 16
6
£30|52 16
20
s. 10|56
12
d. 6|72
4
qrs. 2|88
Prin. 2d year, 508 16 0
Int of ditto, 30 10 6½
Prin. of 3d yr. 539 6 6½
6
£32|35 19 3
20
s. 7|19
12
d. 2|31
4
qr. 1|24

Prin. 3d year, £539 6 6½
Int. of ditto, 32 7 2¼
Amount, *Anſ.* £571 13 8¾
Sub. 1ſt prin. 480
Compound int. for 3 years. } 91 13 8¾

2. What is the compound intereſt of £740 for 6 years, at £4 per cent. per annum?
Anſ. £196 6 8½.

3. What will £150 amount to in a year, at £2 per cent. per month?
Anſ. £190 4 5.

When the rate is at 5 per cent. per annum.

1. Divide the principal by 20, and this quotient, added to the principal, will be the amount for the firſt year, and the principal for the ſecond.

2. In like manner find the amount for every ſucceeding year.

When the rate is at 6 per cent. per annum, you may

1. Divide the principal by 20, and that quotient by 5: Theſe quotients, added to the principal, will be the amount for the firſt year, and the principal for the ſecond.

2. In like manner obtain the amount for every ſucceeding year.

EXAMPLES.

What is the amount of £480, at 6 per cent. per annum, for 4 years?

20)480
5) 24
4 16

20)508 16 amt. of the 1ſt yr.
5) 25 8 9½
5 1 9

20)539 6 6½ ditto of 2d.
5) 26 19 3¾
5 7 10¼

20)571 13 8½ do. of 3d.
5) 28 11 8
5 14 4

£605 19 8½ do. of 4th. *Anſ.*

Of the ſame ſum at 5 per cent. per annum, for 4 years?

20)480
24

10)504 amount of 1ſt yr.
25 4

20)529 4=ditto of 2d.
26 9 2¼

20)555 13 2¼=do. 3d.
27 15 7¾

£583 8 10=do. of (4th. *Anſ.*

COMPOUND INTEREST BY DECIMALS.

A TABLE *of the amount of* £1 *at* 6 *per cent. per annum, for months.*

Mo.	£. dec. part.	Mo.	£. dec. part.	Mo.	£. dec. parts.
1	1,00487	5	1,02457	9	1,04467
2	1,00976	6	1,02956	10	1,04975
3	1,01467	7	1,03457	11	1,05486
4	1,01961	8	1,03961	12	1,06

A TABLE *of the amount of* £1 *from* 1 *day to* 31 *days, at* 6 *per cent. per annum.*

days.	£. dec. part.	days.	£. dec. part.	days.	£. dec. parts.
1	1,00010	12	1,00197	22	1,00361
2	1,00032	13	1,00213	23	1,00378
3	1,00049	14	1,00230	24	1,00394
4	1,00065	15	1,00246	25	1,00410
5	1,00082	16	1,00263	26	1,00427
6	1,00098	17	1,00279	27	1,00443
7	1,00115	18	1,00295	28	1,00460
8	1,00131	19	1,00312	29	1,00476
9	1,00147	20	1,00328	30	1,00493
10	1,00164	21	1,00345	31	1,00509
11	1,00180				

A TABLE *of the amount of* £1 *at* ½ *per cent. per month, as practiſed at the Maſſachuſetts Bank.*

Mo	£. dec. parts.	Mo.	£. dec. parts.	Mo.	£. dec. pts.
1	1,005	5	1,025	9	1,045
2	1,01	6	1,03	10	1,05
3	1,015	7	1,035	11	1,055
4	1,02	8	1,04	12	1,06

CASE I.

When the principal, the rate of intereſt, and time, are given, to find either the amount or intereſt.

RULE 1. Find the amount of £1 for one year, at the given rate per cent.

2. Involve the amount, thus found, to ſuch power, as is denoted by the number of years—or, in Table 1ſt, at the end of Annuities, under the rate, and againſt the given number of years, you will find the power.*

3. Multiply this power by the principal, or given ſum, and the product will be the amount required, from which, if you ſubtract the principal, the remainder will be the intereſt.

EXAMPLES.

1. What is the compound intereſt of £600 for 4 years, at 6 per cent per annum?

$$\begin{array}{rl} 1{,}06 = & \left\{ \begin{array}{l}\text{Amount of £1 for 1 year,}\\ \text{at 6 per cent. per annum.}\end{array}\right. \\ \text{Multiply by } 1{,}06 & \\ \hline 1{,}1236 = & \text{2d power.} \\ \text{Multiply by } 1{,}1236 & \\ \hline 1{,}16247696 = & \text{4th power.} \\ \text{Multiply by } 600 = & \text{principal.} \\ \hline 757{,}48617600 = & \text{amount.} \\ \text{Subt. } 600 & \\ \hline 157{,}486176 = & \text{£157 9s. } 8\tfrac{1}{2}\text{d.} = \text{Int. required.} \end{array}$$

---

* The amounts of £1 in this Table, are ſo many powers of the amount of £1 for 1 year, whoſe indices are denoted by the number of years.

Note. When the given time conſiſts of years and months, or years, months and days; firſt ſeek the amount of £1 in the Table for years, then, in the Table of months, &c. multiply theſe ſeveral amounts and the principal continually together, and the laſt product will be the amount required.

Thus, if the amount of £480 in $5\frac{1}{2}$ years, at 6 per cent. per annum, were required; the amount of £1 for 5 years=£1,33822 ditto for 6 months=£1,02956. Now, 1,33822 × 1,02956 × 480 =£661,2341, *Anſ.*

By TABLE I.

Tabular amount of £1 for 4 years, at 6 per cent. per annum, } =1,2624769
Multiply the principal= 600

Amount=757,4861400

Another way of working Compound Intereſt for *years*, *months*, and *days*, which is much more conciſe than the preceding method.

RULE. To the logarithm of the principal, found in any Table of logarithms, add the ſeveral logarithms, anſwering to the number of *years*, *months*, and *days*, found in the following Tables, and their ſum will be the logarithm of the amount for the given time, which being found in any Table of logarithms, the natural number correſponding thereto, will be the anſwer.

Logarithmic TABLES, *at* 6 *per cent. per annum, for years, months, and days.*

Ys	*dec. pts.*	*Y.*	*dec. pts.*	*Y.*	*dec. pts.*	*Y.*	*dec. pts.*	*M.*	*dec. pts.*
1	,025306	11	,278366	21	,531426	31	,784586	1	,002166
2	,050612	12	,303672	22	,556732	32	,809792	2	,004321
3	,075918	13	,328978	23	582038	33	,835098	3	,006466
4	,101224	14	,354284	24	,607344	34	,860404	4	,0086
5	,12653	15	,37969	25	,63265	35	,88571	5	,010724
6	,151836	16	,404896	26	,657956	36	,911016	6	.012837
7	,177142	17	.430202	27	,683262	37	,936322	7	,01494
8	,202448	18	,455508	28	,708568	38	,961628	8	,017033
9	,227754	19	,480814	29	.733974	39	,986934	9	,019116
10	,25306	20	,50612	30	,75938	40	1,01224	10	,021189
								11	,023252
days		*D.*		*D.*		*D.*		*D.*	
1	000071	8	,000571	14	,000999	20	.001426	26	,001852
2	000143	9	,000642	15	,00107	21	,001497	27	,001923
3	000215	10	,000713	16	,001142	22	,001568	28	,001994
4	000287	11	,000785	17	,001213	23	,001639	29	,002065
5	000358	12	,000857	18	,001284	24	,00171	30	,002136
6	000429	13	,000928	19	,001355	25	,001781	31	.002207
7	0005								

What is the amount of £132 10s. at 6 per cent. per annum, for 9 years, 8 months, and 15 days?

To the Log. of £132,5=2,12222

$$\text{Add}\begin{cases}\text{Log. for 9 years}= & ,22775\\ \text{ditto for 8 months}= & ,01703\\ \text{ditto for 15 days}= & ,00107\end{cases}$$

2,36807 the neareſt to which, in the Table of Logarithms, is 2,36810, and the natural number anſwering thereto is 233,4=£233 8s. *Anſ.*

CASE II.

When the amount, rate and time are given, to find the principal.

RULE. Divide the amount by the amount of £1 for the given time, and the quotient will be the principal.

Or, If you multiply the preſent value of £1 for the given number of years, at the given rate per cent. by the amount, the product will be the principal, or preſent worth.

EXAMPLE.

What is the preſent worth of £757 9s. 8½d. due 4 years hence, diſcounting at the rate of £6 per cent. per annum?

By Tab.1ſt, divide by the tabular amount of £1 for 4 years. } =£1,2624769)757,4861400(600
(*Anſ.*

By TABLE II.

Amount=757,48614
Mult. by the preſent worth of £1 for 4 years, at 6 per cent. per annum. } =,79,20936

Anſ. 599,999235827704+=£600

CASE III.

When the principal, rate and amount are given, to find the time.

Rule. Divide the amount by the principal; then divide this quotient by the amount of £1 for 1 year, this quotient by the ſame till nothing remain, and the number of the diviſions will ſhow the time.

Or, Divide the amount by the principal, and the quotient will be the amount of £1 for the given time, which ſeek under the given rate in Table 1ſt, and in a line with it, you will ſee the time.

Example.

In what time will £600 amount to £757 9s. 8½d. at 6 per cent. per annum, compound intereſt?

Divide the amount by the principal, } =600)757,486176(1,26247696= (quotient to be divided by 1,06 till it can be had no more; or you may find it in Table 1ſt, under 6 per cent. and againſt 4 years.

Divide by 1,06)1,26247696

1,06)1,191016

1,06)1,1236

1,06)1,06

1

Four diviſions ſhow the time to be 4 years.

CASE IV.

When the principal, amount and time are given, to find the rate per cent.

Rule. Divide the amount by the principal, and the quotient will be the amount of £1 for the given time; then, extract ſuch root as the time denotes, and that root will be the amount of £1 for 1 year, from which ſubtract unity, and the remainder will be the ratio.

Or, Having found the amount of £1 for the time, as above directed, look for it in Table 1ſt, even with the given time, and directly over the amount you will find the ratio.

E X A M P L E.

At what rate per cent. per annum will £600 amount to £757 9/8½ in 4 years?
600)757,48614(1,2624769.—Now, the time being 4 years, the 4th root of this quotient minus 1 will be the ratio.

· · · · · · · · · ·
1,26247690)1,123599 + and 1,123599(1,05999 + and 1,05999—1=,06 *Anſ.*

DISCOUNT BY COMPOUND INTEREST.

C A S E I.

The ſum, or debt to be diſcounted, the time and rate given, to find the preſent worth.

Rule. Divide the debt by that power of the amount of £1 for 1 year, denoted by the time, and the quotient will be the preſent worth, which, ſubtracted from the debt, will leave the diſcount.

E X A M P L E S.

1. What is the preſent worth, and diſcount, of £600, due 3 years hence, at £6 per cent. per annum, compound intereſt?
Divide by $\overline{1,06}|^3$ = 1,19101)600,00000(503,7741 = £503 15/5¾ preſent worth; and £100—£503 15 5¾= £96 4s. 6¼d = Diſcount.

Bu

By TABLE 2d. In this table, correſponding to the time and rate, we

have ,839619=*preſent worth of £*1 *for the time and rate.*
Mult. by 600=*debt, or principal.*

503,771400=preſent worth of the debt.

2. What is the preſent worth of £312 10s. due 2 years hence, at 4½ per cent. per annum, compound intereſt? *Anſ.* £286 3s. 3d. 2,97 qrs.

3. What ready money will diſcharge a debt of £1000 due 4 years hence, at £5 per cent. per annum, compound intereſt? *Anſ.* £822 14s. 0d. 2,304 qrs.

ANNUITIES OR PENSIONS IN ARREARS, AT COMPOUND INTEREST.

CASE I.

When the annuity, or penſion, the time it continues, and the rate per cent. are given, to find the amount.

RULE 1. Make 1 the firſt term of a Geometrical Progreſſion, and the amount of £1 for 1 year at the given rate per cent. the ratio.

2. Carry the ſeries to ſo many terms as the number of years, and find its ſum.

3. Multiply the ſum, thus found, by the given annuity, and the product will be the amount ſought. Or, Multiply the amount of £1 for 1 year into itſelf ſo many times as there are years, leſs by 1; then multiply this product by the annuity; and ſubtract the annuity therefrom; laſtly, divide the remainder by the ratio leſs 1, and the quotient will be the amount.

EXAMPLES.

EXAMPLES.

1. What will an annuity of £60 per annum, payable yearly, amount to in 4 years, at £6 per cent.?

Firſt Method.

$$1+1{,}06+\overline{1{,}06}|^{2}+\overline{1{,}06}|^{3}\times 60=\text{£}262\ 9\text{s. }6\tfrac{1}{4}\text{d.}$$

Second Method.

$$\frac{\overline{1{,}06\times 1{,}06\times 1{,}06\times 1{,}06}\times 60-60}{1{,}06-1}=262{,}49$$

Or, By TABLE III.

Multiply the tabular number under the rate, and oppoſite the time, by the annuity, and the product will be the amount.

2. What will an annuity of £60 per annum, amount to in 20 years, allowing £6 per cent. compound intereſt?

Under 6 per cent. and oppoſite 20, in Table 3d, you will find tabular number=36,78559.

Multiply by 60=Annuity.

2207,13540=£2207 2s. 8¼d. (the *Anſ.*

CASE II.

When the amount, rate per cent. and time are given, to find the annuity, penſion, &c.

RULE. Multiply the whole amount by the amount of £1 for 1 year, from which ſubtract the whole amount; divide the remainder by that power of the amount of £1 for 1 year, ſignified by the number of years, made leſs by unity, and the quotient will be the anſwer.

EXAMPLES.

EXAMPLES.

1. What annuity, being forborne 4 years, will amount to 262,47696, at £6 per cent. compound intereſt?

$$\frac{262,47696 \times 1,06 - 262,47696}{1,06 \times 1,06 \times 1,06 \times 1,06 - 1} = 60$$

Or, By TABLE III.

Divide the amount by the tabular number under the rate, and oppoſite to the time, and the quotient will be the annuity.

2. What annuity, being forborne 20 years, will amount to £2207,1354, at £6 per cent. compound intereſt?

Tabular amount = 36,78559)2207,13540(60 *Anſ.*
2207,1354

0

CASE III.

When the annuity, amount and ratio are given, to find the time.

RULE. Multiply the amount by the ratio, to this product add the annuity, and from the ſum ſubtract the amount; this remainder being divided by the annuity, the quotient will be that power of the ratio ſignified by the time, which being divided by the amount of £1 for 1 year, and this quotient by the ſame, till nothing remain, the number of thoſe diviſions will be equal to the time. Or, look for this number under the given rate in Table I. and, in a line with it, you will ſee the time.

EXAMPLE.

1. In what time will £60 per annum, payable yearly, amount to 262,47696, allowing £6 per cent. compound intereſt for the forbearance of payment?

In Table I. under the given rate, you will find 1,262476, and in a line, under years, you will find 4.

PRESENT WORTH OF ANNUITIES, &c. AT COMPOUND INTEREST.

CASE I.

When the annuity, &c. rate and time are given, to find the preſent worth.

RULE* 1. Divide the annuity by the ratio, or the amount of £1 for 1 year, and the quotient will be the preſent worth of 1 year's annuity.

2. Divide the annuity by the ſquare of the ratio, and the quotient will be the preſent worth for two years.

3. In like manner, find the preſent worth of each year by itſelf, and the ſum of all theſe will be the preſent value of the annuity ſought.

Or, Divide the annuity, &c. by that power of the ratio ſignified by the number of years, and ſubtract the quotient from the annuity: This remainder being divided by the ratio leſs 1, the quotient will be the preſent worth.

EXAMPLE.

1. †What ready money will purchaſe an annuity of

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[*] The amount of an annuity may alſo be found for years and parts of a year, thus:

1. Find the amount for the whole years, as before.
2. Find the intereſt of that amount for the given parts of a year.
3. Add this intereſt to the former account, and it will give the whole amount required.

The preſent worth of an annuity for years and parts of a year, may be found thus:

1. Find the preſent worth for the whole years, as before.
2. Find the preſent worth of this preſent worth, diſcounting for the given parts of a year, and it will be the whole preſent worth required.

† Queſtions in this caſe may alſo be anſwered by firſt finding the amount of the given annuity by Caſe 1, of annuities in arrears, page 308, and then the preſent worth, or principal, by Caſe 2, of Compound Intereſt, page 305.

of £60, to continue 4 years, at £6 per cent. compound intereſt?

$$\frac{60}{,06|^{4}}=47,525 \quad 60-47,525=12,475$$

$$\text{And}\frac{12,475}{,06}=207,916$$

By TABLE III.

Under £6 per cent. and oppoſite 4, we find
4,37461 = Amount of £1 annuity for 4 years.
Multiply by 60 = Annuity.

262,47660 = Amount of £60 for 4 years.
Then oppoſite 4 years, and under £6 per cent. in Table II. we have, ,792093 and ,792093 × 262,7466 = (208,1197 +

Or, oppoſite 4 years, and under £6 per cent. in Table I. we have 1,26247 = the amount of £1 for 4 years: Then, 262,7466 ÷ 1,26247 = 208,0219 = £208 2s. 5d. the *Anſwer*.

By TABLE IV.

Multiply the tabular number, under the rate, and oppoſite the time, into the annuity, and the product will be the preſent worth.

Thus, in Example 1ſt. What ready money will purchaſe £60 annuity, to continue 4 years, at £6 per cent. compound intereſt?

Under £6 per cent. and even with 4 years,
We have 3,4651 = preſent worth of £1 for 4 years.
Mult. by 60 = annuity.

Anſ. = 207,9060 = £207 18s. $1\frac{1}{4}$d.

CASE

CASE II.

When the preſent worth, time and rate are given, to find the annuity, rent, &c.

Rule 1. From that power of the ratio denoted by the number of years plus 1, ſubtract that power of it, denoted by the number of years.

2. Divide the remainder by that power of the ratio, ſignified by the time made leſs by unity.

3. Multiply the preſent worth into this quotient, and the product will be the annuity, penſion, rent, &c.

Or, 1. Multiply that power of the ratio, denoted by the number of years plus 1, by the preſent worth.

2. Multiply that power of the ratio denoted by the time by the preſent worth, and ſubtract this product from the former.

3. Divide the remainder by that power of the ratio, denoted by the time made leſs by unity, and the quotient will be the annuity.

EXAMPLE.

What annuity, to continue 4 years, will £207,904 purchaſe, compound intereſt, at £6 per cent?

Firſt Method.

From 1,06 × 1,06 × 1,06 × 1,06 × 1,06 = 1,3382255776
Subt. 1,06 × 1,06 × 1,06 × 1,06 = 1,26247696

Divide by $\overline{1,06}|^4 - 1$ = ,26247696),0757486176(,2885898
And ,2885898 × 207,9 = £60.

Second Method.

From 1,06 × 1,06 × 1,06 × 1,06 × 1,06 × 207,9 = 278,217097573
Take 1,06 × 1,06 × 1,06 × 1,06 × 207,9 = 262,468959984

Divide by $\overline{1,06}|^4 - 1$ = ,26247696)15,748137589
(59,998 = £60.

By TABLE V.

Multiply the tabular number, correſponding with the rate and time, by the purchaſe money, and the product will be the annuity.

Under £6 per cent. and oppoſite 4 years, you will find ,28859=annuity which £1 will purchaſe in 4 years; and ,28859×207,9=£60.

CASE III.

When the annuity, preſent worth, and ratio, are given, to find the time.

RULE. Divide the annuity by the product of the preſent worth and ratio ſubtracted from the ſum of the preſent worth and annuity, and the quotient will be that power of the ratio, denoted by the number of years, which being divided by the ratio, and this quotient by the ſame until nothing remain, the number of diviſions will ſhow the time:— *Or*, the above quotient being ſought in Table I. under the given rate, in a line with it, you will ſee the time.

EXAMPLE.

For how long may an annuity of £60 per annum be purchaſed for £207,906336762 at £6 per cent. compound intereſt?

$$\frac{60}{207,906336762+60-207,906336762\times 1,06}=1,26247696$$

which being ſought in Table I. under the given rate, in a line with it, is 4=4 years.

ANNUITIES, LEASES, &c. TAKEN IN REVERSION, AT COMPOUND INTEREST.

CASE I.

When the annuity, time and ratio are given, to find the preſent worth of the annuity in reverſion.

RULE 1. Divide the annuity by that power of the ratio, denoted by the time of its continuance.

2. Subtract this quotient from the annuity: Divide the remainder by the ratio leſs 1, and the quotient will be the preſent worth, to commence immediately.

3. Divide this quotient by that power of the ratio denoted by the time of reverſion (or, time to come, before the annuity commences) and the quotient will be the preſent worth of the annuity in reverſion.

Or, 1. Multiply the annuity by that power of the ratio denoted by the time of its continuance, minus unity for a dividend.

2. Multiply that power of the ratio denoted by the time of its continuance, that power of it, denoted by the time of reverſion, and the ratio leſs 1 continually together for a diviſor, and the quotient ariſing from the diviſion of theſe two numbers will be the preſent worth of the annuity in reverſion.

EXAMPLES.

1. What is the preſent worth of £60, payable yearly, for 4 years; but not to commence until 2 years hence at £6 per cent.?

In Table IV. find the preſent value of £1 at the given rate, both for the time in being and the time in reverſion added together, and ſubtract the preſent worth of the time in being from the other, multiply the remainder by the annuity, and the product will be the anſwer.

Preſent worth of time in being and reverſion=4,91732
Preſent worth of the time in being=1,8333

3,08402
60

£ 185,04120

$$\frac{60}{1,26247696}=47.5256 \qquad \text{Then, } \frac{60-47,5256}{1,06-1}=207,906$$

$$\text{And } \frac{207,906}{1,1236}=185,035876$$

$$\text{Or, } \frac{\overline{1,06}|^{4}-1\times 60}{\overline{1,06}|^{4}\times\overline{1,06}|^{2}\times\overline{1,06-1}}=185,036$$

An annuity, ſeveral times in reverſion, and rate, being given, to find the ſeveral preſent values.

Find the preſent value of £1 per Table IV. at the given rate, and for the ſeveral given times, which being ſeverally multiplied by the anuity, the products will be the ſeveral preſent values of that annuity, for the ſeveral times given; ſubtract the ſeveral preſent values, the one from the other, and the ſeveral remainders will anſwer the queſtion.

2. A has a term of 6 years in an eſtate of £60 per annum. B has a term of 14 years in the ſame eſtate, in reverſion, after the 6 years are expired; and C hath a farther term of 16 years, after the expiration of 20 years: I demand the preſent values of the ſeveral terms, at 6 per cent.?

£. s. d.
Preſ. val of £1 for 36 yrs. = 14,61722 × 60 = 877 0 $7\frac{3}{4}$
Ditto of ditto for 20 = 11,46992 × 60 = 688 3 $10\frac{3}{4}$
Ditto of ditto for 6 = 491732 × 60 = 295 0 $9\frac{1}{4}$ = *A's term.*
Therefore, 877 0 $7\frac{3}{4}$ — 688 3 $10\frac{3}{4}$ = £188 16 9 = *C's term, and*
688 3 $10\frac{3}{4}$ — 295 0 $9\frac{1}{4}$ = £393 3 $1\frac{1}{2}$ = *B's term.*

3. For a leaſe of certain profits for 7 years, A offers to pay £300 gratuity, and £300 per annum; B offers £800 gratuity, and £250 per annum; C bids £1300 gratuity, and £200 per annum, and D bids £2500 for the whole purchaſe, without any yearly rent; which is the beſt offer, computing at 6 per cent.?

£.
By Table IV. the preſent worth of £300 per annum, for 7 years, at 6 per cent. is 1674,714
To which add 300

Value of A's offer = 1974,714

Preſent worth of £250 per ann. for 7 years = 1395,595
To which add 800

Value of B's offer = 2195,595

Preſent worth of £200 per ann. for 7 years = 1116,476
To which add 1300

Value of C's offer = 2416,476

D's offer = 2500

Hence it appears that D's offer is the beſt.

The above queſtions may be anſwered by the 4th and 2d Tables. Take queſtion 1ſt for example.

1. Multiply the tabular number in Table IV. correſponding to the rate and the time of continuance, into the annuity, and the product will be the preſent worth, to commence immediately.

2. Multiply this preſent worth by the tabular number in Table II. correſponding to the rate and the time of reverſion, and the product will be the preſent worth of the annuity in the reverſion.

in Table 4th we have 3,4651
Multiply by 60=Annuity.

207,9060
In Table 2d we have ,889996 & 207,906X889996=185,0355+
(Preſent worth of the reverſion.

CASE II.

When the preſent worth of the reverſion, rate and time are given, to find the annuity.

Rule 1. Multiply that power of the ratio ſignified by the time of reverſion by the preſent worth, and the product will be the amount of the preſent worth for the time before the annuity commences.

2. Multiply that power of the ratio ſignified by the time of continuance plus 1 by the laſt product.

3. Multiply that power of the ratio ſignified by the time by the aforeſaid product, and this laſt product, di-

vided by that power of the ratio denoted by the time, minus unity, will give the annuity.

Or, divide the continued product of the preſent worth, that power of the ratio denoted by the time of continuance, that power of it denoted by the time of reverſion, and the ratio minus 1, by that power of the ratio denoted by the time of continuance minus 1, and the quotient will be the annuity.

EXAMPLES.

1. What annuity, to be entered upon 2 years hence, and then to continue 4 years, may be purchaſed for £185,035876 at £6 per cent. ?

Method 1.—$185,036 \times 6,1236 = 207,906$

$$\text{Then } \frac{207,906 \times 1,33822 - 207,906 \times 1,26247}{1,26247 - 1} = £60 \; (\textit{Anſ.}$$

Or, by Table IV. Divide the preſent worth of the reverſion by the difference between the preſent worth of £1 for the time both in being and reverſion, and the time in being, and the quotient will be the annuity.

$$\textit{Meth. } 2. \; \frac{185,036 \times 1,26247 \times 1,1236 \times \overline{1,06 - 1}}{1,26247 - 1} = 60.$$

2. The preſent worth of a leaſe of a houſe is £431 15s. 7d. 2,7819qrs. taken in reverſion for 20 years, but not to commence until the end of 8 years, allowing £6 per cent. to the purchaſer ; what is the yearly rent ?

Anſ. £60.

TABLE

TABLE FIRST.

Showing the amount of £1 from one Year to forty Years.

ys.	*5 per cent.*	*6 per cent.*	*ys.*	*5 per cent.*	*6 per cent.*
1	1,0500000	1,0600000	21	2,7859625	3,3995636
2	1,1025000	1,1236000	22	2,9252607	3,6035374
3	1,1576250	1,1910160	23	3,0715237	3,8197496
4	1,2155062	1,2624769	24	3,2250999	4,0489346
5	1,2762815	1,4382256	25	3,3863549	4,2918707
6	1,3400956	1,4185191	26	3,5556716	4,7493829
7	1,4071004	1,5036302	27	3,7334563	4,8223459
8	1,4774554	1,5938480	28	3,9201291	5,1116867
9	1,5513282	1,6894789	29	4,1161356	5,4183879
10	1,6288946	1,7908476	30	4,3219423	5,7434912
11	1,7103293	1,8982985	31	4,5380394	6,0881007
12	1,7958563	2,0121964	32	4,7649414	6,4533867
12	1,8856491	2,1329282	33	5,0031885	6,8405899
14	1,9799316	2,2609039	34	5,2533479	7,2510253
15	2,0789281	2,3965581	35	5,5160152	7,6860868
16	2,1828745	2,5472719	36	5,7918101	8,147252
17	2,2920183	2,6927727	37	6,0814069	8,6860871
18	2,4066192	2,8543391	38	6,3854772	9,1542523
19	2,5269502	3,0255995	39	6,7047511	9,7035074
20	2,6532977	3,2071355	40	7,0399887	10,2857178

TABLE

TABLE SECOND.

Showing the preſent Value of £ 1 due at the end of any number of Years. from 1 to 40.

ys.	5 per cent.	6 per cent.	ys.	5 per cent.	6 per cent.
1	,952381	,943396	21	,358942	294255
2	,90703	,889996	22	,34185	,277505
3	,863838	,889619	23	,325571	,261797
4	,822702	,792093	24	,310068	,246978
5	,783526	,747258	25	,305303	,232998
6	,746215	,70496	26	,281241	,21981
7	,710681	,665057	27	,267848	,207368
8	,676839	,622412	28	,255094	,19563
9	644609	,594898	29	,242946	,184556
10	,613913	,558394	30	,231377	,17411
11	,584679	.562787	31	,220359	,164253
12	,556837	,496969	32	,209866	,154957
13	,530321	,468839	33	,199872	,146186
14	,505068	,442301	34	,190355	,137912
15	,481017	,417265	35	,18129	,130105
16	,458311	,393047	36	,172057	,122741
17	,436297	,371364	37	,164436	,115793
18	,415521	,350343	38	,156605	,109182
19	,395734	,330513	39	,149148	,103055
20	,376889	,311804	40	,142046	,097222

TABLE THIRD.

Shewing the amount of £1 Annuity for any number of Years, from 1 *to* 40.

ys.	5 *per cent.*	6 *per cent.*	*ys.*	5 *per cent.*	6 *per cent.*
1	1,	1,	21	35,719252	39,992725
2	2,05	2,06	22	38,505214	43,392289
3	3,1525	3,1836	23	41,430475	46,995826
4	4,310125	4,374616	24	44,501999	50,815576
5	5,525631	5,637093	2	47,727099	54,86451
6	6,801913	6,975318	26	51,113454	59,156381
7	8,142008	8,393837	27	54,669126	63,705763
8	9,549109	9,897467	28	58,402583	68,528109
9	11,026564	11,491315	29	62,322712	73,639796
10	12,577892	13,180794	30	66,438847	79,058183
11	14,206782	14,971642	31	70,76079	84,801674
12	15,917126	16,86994	32	75,298829	90,889775
13	17,712983	18,882132	33	80,06377	97,343161
14	19,598632	21,015064	34	85,066959	104,103751
15	21,578563	23,075968	35	90,320307	111,434776
16	23,657492	25,672527	36	95,836323	119,120863
17	25,840366	28,212879	37	101,628139	127,268114
18	28,132385	30,905652	38	107,709546	135,904201
19	30,529004	33,759991	39	114,095025	145,058453
20	33,065954	36,78559	40	120,799774	154,76196

TABLE FOURTH.

Showing the preſent worth of £1 Annuity, for any number of Years, from 1 to 40.

ys.	5 *per cent*	6 *per cent.*	*ys.*	5 *per cent.*	6 *per cent.*
1	0,95238	0,94339	21	12,82115	11,76407
2	1,85941	1,83339	22	13,163	12,04158
3	2,72325	2,67301	23	13,48807	12,30338
4	3,54595	3,4651	24	13,79864	12,55035
5	4,32948	4,21236	25	14,09394	12,78335
6	5,07569	4,91732	26	14,37518	13,00316
7	5,78637	5,58238	27	14,64303	13,21053
8	6,46321	6,20979	28	14,89813	13,40616
9	7,10782	6,80169	29	15,14107	13,59072
10	7,72173	7,36008	30	15,37245	13,76483
11	8,30641	7,88687	31	15,59281	13,92908
12	8,86325	8,38384	32	15,80268	14,08398
13	9,39357	8,85268	33	16,00255	14,22917
14	9,89864	9,29498	34	16,1929	14,36613
15	10,37966	9,71225	35	16,37419	14,49533
16	10,83777	10,10589	36	16,54685	14,61722
17	11,27407	10,47726	37	16,71129	14,73211
18	11,68958	10,8276	38	16,86789	14,84048
19	12,08532	11,15811	39	17,01704	14,9427
20	12,46221	11,46992	40	17,15909	15,03193

TABLE FIFTH.

The Annuity which £ 1 will purchaſe for any number of Years to come, from 1 *to* 40.

yrs.	5 *per cent.*	6 *per cent.*	yrs.	5 *per cent.*	6 *per cent.*
1	1,05	1,06	21	,078	,085
2	,5378	,54544	22	,07597	,08303
3	,36721	,37411	23	,07414	,08128
4	,28201	,28859	24	,07247	,07968
5	,23097	,23739	25	,07095	,07823
6	,19702	,20336	26	,06956	,0769
7	,17282	,17913	27	,06829	,0717
8	,15473	,16103	28	,06712	,07459
9	,14069	,14702	29	,06604	,07358
10	,1295	,13587	30	,06505	,07272
11	,12039	,12679	31	,06413	,07179
12	,11282	,11927	32	,06328	,071
13	,10645	,11296	33	,06249	,07027
14	,10102	,10758	34	,06175	,06959
15	,09624	,10296	35	,06107	,06899
16	,09227	,09895	36	,06043	,06839
17	,0887	,09544	37	,05984	,06785
18	,08555	,09235	38	,05928	,06735
19	,08274	,08962	39	,05876	,06689
20	,08024	,08718	40	,00828	,06646

ALLIGATION

Is the method of mixing two or more ſimples of different qualities, ſo that the compoſition may be of a mean or middle quality: It conſiſts of two kinds, viz. Alligation Medial, and Alligation Alternate.

ALLIGATION MEDIAL

Is when the quantities and prices of ſeveral things are given to find the mean price of the mixture compounded of thoſe things.

Rule. As the ſum of the quantities, or the whole compoſition, is to their total value; ſo is any part of the compoſition to its mean price or value.

Examples.

1. A tobacconiſt would mix 60lb. of tobacco, at 6d. per lb. with 50lb. at 1s. 40lb. at 1s. 6d. and 30lb. at 2s. per lb.—What is 1lb. of this mixture worth?

lb.	s.	d.	£.	s.
60 at	0	6 is	1	10
50	1	0—	2	10
40	1	6—	3	0
30	2	0—	3	0
Amt. of ſimps. 180 lb. =			£10	0

lb. £. lb.
As 180 : 10 :: 1
1
——
10
20
——
180)200(1s.
180
——
20
12
——
180)240($1\frac{1}{3}$d.
180
——
60

s. d.
Anſ. 1 $1\frac{1}{3}$ per lb.

2. A farmer would mix 20 buſhels of wheat, at 6s. per buſhel; 16 buſhels of rye, at 4s. per buſhel; 12 buſhels of barley, at 3s. per buſhel, and 8 buſhels of oats at 2s. per buſhel: What is the value of 1 buſhel of this mixture? *Anſ.* 4s. $2\frac{1}{2}$d.

3. A wine merchant mixes 12 gallons of wine, at 4s. 10d. per gallon, with 24 gallons, at 5s. 6d. and 16 gallons, at 6s. $3\frac{1}{4}$d.—What is a gallon of this compoſition worth? *Anſ.* 5s. 7d.

4. A goldſmith melted together 8oz. of gold of 22 carats fine, 1lb. 8oz. of 21 carats fine, and 10oz. of 18 carats fine: Pray what is the quality, or fineneſs, of the compoſition?

$$\frac{8\times22+20\times21+10\times18}{8+20+10}=20\tfrac{8}{19}\text{ carats fine, Anſ.}$$

5 A refiner melts 5lb. of gold of 20 carats fine, with 8lb. of 18 carats fine: How much alloy muſt he put to it, to make it 22 carats fine?

$$22-\overline{\overline{5\times20}+\overline{8\times18}\div\overline{5+8}}=3\tfrac{3}{13}$$

Anſ. It is not fine enough, by $3\frac{3}{13}$ carats, ſo that no alloy muſt be added, but more gold.

ALLIGATION ALTERNATE[*]

Is the method of finding what quantity of each of the ingredients, whoſe rates are given, will compoſe a mixture of a given rate: So that it is the reverſe of Alligation Medial and may be proved by it.

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[*] By connecting the leſs rate with the greater, and placing the difference between them and the mean rate alternately, or one after the other in turn, the quantities reſulting are ſuch that there is preciſely as much gained by one quantity as is loſt by the other; and therefore the gain and loſs upon the whole, are equal, and are exactly the propoſed rate.

In like manner, let the number of ſimples be what it may, and with how many ſoever each one is linked, ſince it is always a leſs with a greater than the mean price, there will be an equal balance of loſs and gain between every two, and conſequently an equal balance on the whole.

It is obvious from the rule, that queſtions of this ſort admit of a great variety of anſwers; for having found 1 anſwer, we may find as many more as we pleaſe, by only multiplying or dividing each of the quantities found, by 2, 3, 4, &c.

If any one of the ſimples be of little or no value with reſpect to the reſt, its rate is ſuppoſed to be nothing, as water mixed with wine, and alloy with gold and ſilver.

CASE I.

The whole work of this caſe conſiſts in linking the extremes truly together, and taking the differences between them and the mean price, which differences are the quantities ſought.

Rule 1. Place the ſeveral prices of the ſimples, being reduced to one denomination, in a column under each other, the leaſt uppermoſt, and ſo gradually downward as they increaſe; with a line of connection at the left hand, and the mean price at the left hand of all.

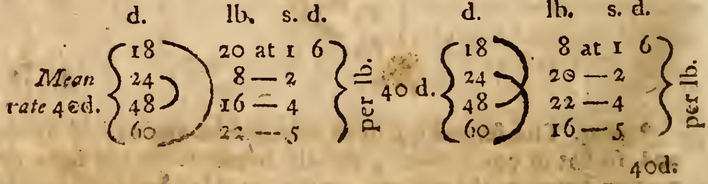
2. Connect with a continued line, the price of each ſimple, or ingredient, which is leſs than that of the compound, with one or any number of thoſe, which are greater than the compound, and each greater rate or price with one, or any number, of the leſs.

3. Place the difference between the mean price (or mixture rate) and that of each of the ſimples oppoſite to the rates with which they are connected.

4. Then, if only one difference ſtand againſt any rate, it will be the quantity belonging to that rate; but if there be ſeveral, their ſum will be the quantity.

Examples.

1. A merchant has ſpices, ſome at 1s. 6d. per lb. ſome at 2s. ſome at 4s. and ſome at 5s. per lb.—How much of each ſort muſt he mix, that he may ſell the mixture at 3s. 4d. per lb.?



	d.		lb.	s. d.	
40d.	18	20+8	28 at	1 6	per lb.
	24	8	8—	2	
	48	16+22	38—	4	
	60	22	22—	5	

	d.		lb.	s. d.	
40d.	18	20	20 at	1 6	per lb.
	24	8+20	28—	2	
	48	16	16—	4	
	60	22+16	38—	5	

	d.		lb.	s. d.	
40d.	18	20+8	28 at	1 6	per lb.
	24	8+20	28—	2	
	48	16+22	38—	4	
	60	22+16	38—	5	

Note. Theſe five anſwers ariſe from as many various ways of linking the rates of the ingredients together.

2. * A merchant has Canary wine, at 3s. per gallon; Sherry at 2s. 1d. and Claret at 1s. 5d. per gallon: How much of each ſort muſt he take to ſell it at 2s. 4d. per gallon?

				s. d.	
Mean rate 28d.	36	3+11	14 at	3 0	per gall.
	25	8	8—	2 1	
	17	8	8—	1 5	

3. A goldſmith would mix gold of 19 carats fine, with ſome of 16, 18, 23 and 24 carats fine, ſo that the compound may be 21 carats fine: What quantity of each muſt he take?

21.	16
	18
	19
	23
	24

---

* *Note*, The ſecond queſtion admits but one way of linking, and ſo but of one anſwer; yet all numbers in the ſame proportion between themſelves, as the numbers which compoſe the anſwer, will likewiſe ſatisfy the condition of the queſtion.

4. It is required to mix ſeveral ſorts of wine at 3s. 5s. and 7s. per gallon, with water, that the mixture may be worth 4s. per gallon: How much of each ſort muſt the mixture conſiſt of?

$$4\left\{\begin{array}{l}0\\3\\5\\7\end{array}\right.$$

Anſ. 3 gal. water 1 gal. wine, at 3s. 1 ditto, at 5s. and 4 ditto at 7s.

C A S E II.

When the rates of all the ingredients, the quantity of but one of them, and the mean rate of the whole mixture, are given, to find the ſeveral quantities of the reſt in proportion to the quantity given.

Rule. Take the differences between each price and the mean rate and place them alternately, as in Caſe 1. Then, as the difference ſtanding againſt that ſimple, whoſe quantity is given, is to that quantity; ſo is each of the other differences, ſeverally, to the ſeveral quantities required.

Examples.

1. A merchant has 40lb. of tea, at 6s. per lb. which he will mix with ſome at 5s. 8d. ſome at 5s. 2d. and ſome at 4s. 6d.—How much of each ſort muſt he take, to mix with the 40lb. that he may ſell the mixture at 5s. 5d. per lb.?

$$\begin{array}{l} \text{d.} \\ 65 \end{array}\left\{\begin{array}{l}54\\62\\68\\72\end{array}\right. \quad \begin{array}{r}7+3\\3+7\\3+11\\11+3\end{array}\left|\begin{array}{l}\text{lb.}\\10\\10\\14\\14\end{array}\right.$$

14 ſtands againſt the given quantity.

$$\text{As } 14 : 40 :: \left\{\begin{array}{l} \text{lb.} \quad \text{lb.} \\ 10 : 28\tfrac{8}{14} \text{ at 4s. 6d.} \\ 10 : 28\tfrac{8}{14} \text{ — 5s. 2d.} \\ 14 : 40 \quad \text{— 5s. 8d.} \end{array}\right\} \text{per lb.}$$

2. How much gold, of 16, 20 and 24 carats fine, and how much alloy, muſt be mixed with 10oz. of 18 carats fine, that the compoſition may be 22 carats fine?

Anſ. 10oz. of 16 carats fine, 10 of 20, 170 of 24, and 10 of alloy.

ALTERNATION TOTAL.

C A S E III.

When the rates of the ſeveral ingredients, the quantity to be compounded, and the mean rate of the whole mixture are given, to find how much of each ſort will make up the quantity.

Rule. Place the differences between the mean rate, and the ſeveral prices alternately, as in Caſe 1ſt. Then, As the ſum of the quantities, or differences thus determined, is to the given quantity or whole compoſition; ſo is the difference of each rate, to the required quantity of each rate.

EXAMPLES.

1. Suppoſe I have 4 ſorts of currants, at 8d. 12d. 18d. and 22d. per lb.—the worſt would not ſell and the beſt were too dear; I therefore concluded to mix 120lb. and ſo much of each ſort, as to ſell them at 16d. per lb.—How much of each ſort muſt I take?

$$\begin{array}{rl} & \text{d.} \quad \text{lb.} \\ 16\text{d.} & \left\{\begin{array}{rl} 8 & 6 \\ 12 & 2 \\ 18 & 4 \\ 22 & 8 \end{array}\right. \end{array} \text{As } \overset{\text{lb.}}{20} : \overset{\text{lb.}}{120} :: \left\{\begin{array}{l} \overset{\text{lb.}}{6} : \overset{\text{lb.}}{36} \text{ at } 8\text{d.} \\ 2 : 12 - 12\text{d.} \\ 4 : 24 - 18\text{d.} \\ 8 : 48 - 22\text{d.} \end{array}\right\} \text{pr. lb.}$$

Sum = 20   120

2. A goldſmith has ſeveral ſorts of gold, viz. of 15, 17, 20 and 22 carats fine, and would melt together, of all theſe ſorts, ſo much as may make a maſs of

40oz. 18 carats fine ; how much of each ſort is required ?

Anſ. 16oz. 15 carats fine, 4oz. 17, 8oz. 20, and 12oz. of 22 carats fine.

3. How many gallons of water, of no value, muſt be mixed with wine at 4s. per gallon, ſo as to fill a veſſel of 80 gallons, that may be afforded at 2s. 9d. per gallon ?

$$\begin{array}{llll} & \text{Gal.} & & \\ 33\left\{\begin{matrix}0\\48\end{matrix}\right) & \begin{matrix}15\\33\end{matrix} & \text{Gal.}\quad\text{Gal.} & \text{Gal.}\\ \text{Sum} & \overline{48} & \text{As } 48 : 80 :: & \left\{\begin{matrix}15 : 25 \text{ of water}\\ 33 : 55 \text{ of wine}\end{matrix}\right\} \textit{Anſ.}\end{array}$$

C A S E IV.

When more than one of the ſimples are limited.

Rule. Find by Alligation Medial, what will be the rate of a mixture made of the given quantities of the limited ſimples only ; then, conſider this as the rate of a limited ſimple, whoſe quantity is the ſum of the firſt given limited ſimples, from which and the rates of the unlimited ſimples, by Caſe 2d. calculate the quantity.

Example.

How much wine at 4s. 6d. and at 5s. per gallon, muſt be mixed with 6 gallons at 4s. and 6 gallons at 3s. per gallon, that the mixture may be worth 4s. 4d. per gallon ?

$$\begin{array}{ll} & \text{Gal.}\quad\text{s.}\quad\text{Gal.}\\ \begin{matrix}\text{Limited}\\ \text{ſimples}\end{matrix}\left\{\begin{matrix}6 \text{ gallons at } 4\text{s.} = 24\\ 6 \text{ gallons at } 3\text{s.} = \underline{18}\end{matrix}\right\} & \text{As } 12 : 42 :: 1 : 3/6\\ \qquad\qquad\ \ 12 \qquad\qquad\qquad\ \ 42 & \qquad\qquad\text{(per gal.}\end{array}$$

Now, having found the rate of the limited ſimples, the queſtion may ſtand thus : How much wine at 4s. 6d. and 5s. per gallon, muſt be mixed with 12 gallons at 3s. 6d. per gallon, that the mixture may be worth 4s. 4d. per gallon ?

$$52\left\{\begin{array}{l}42\\54\\60\end{array}\right.\quad\begin{array}{r|l}2+8&10\\10&10\\10&10\end{array}$$

$$\text{As } 10:\left\{\begin{array}{c}10\\10\end{array}\right\}::12:\left\{\begin{array}{l}\text{12 gallons at 4/6}\\\text{12 gallons at 5s.}\end{array}\right\}\begin{array}{l}\text{per gallon}\\\textit{Anſ.}\end{array}$$

POSITION.

Poſition is a rule, which by falſe, or ſuppoſed numbers, taken at pleaſure, diſcovers the true ones required. It is divided into two parts ; Single and Double.

SINGLE POSITION.

Single Poſition teaches to reſolve thoſe queſtions, whoſe reſults are proportional to their ſuppoſitions ; ſuch are thoſe, which require the multiplication or diviſion of the number ſought by any propoſed number ; or when it is to be increaſed or diminiſhed by itſelf a certain propoſed number of times.

Rule 1. Take any number and perform the ſame operations with it, as are deſcribed to be performed in the queſtion.

2. Then ſay ; As the ſum of the errors is to the given ſum ; ſo is the ſuppoſed number to the true one required.

Proof.—Add the ſeveral parts of the ſum together, and if it agrees with the ſum, it is right.

Examples.

1. A ſchoolmaſter being aſked how many ſcholars he had, ſaid, If I had as many more as I now have, three quarters as many, half as many, one fourth and one eighth as many, I ſhould then have 435 ; of what number did his ſchool conſiſt ?

Suppoſe he had 80
As many $=$ 80
$\frac{3}{4}$ as many $=$ 60
$\frac{1}{2}$ as many $=$ 40
$\frac{1}{4}$ as many $=$ 20
$\frac{1}{8}$ as many $=$ 10

290

As 290 : 435 :: 80
80

29|0)3480|0(120. *Anſ.*
29

58
58

0

120
120
90
60
30
15

Proof 435

2. A perſon lent his friend a ſum of money unknown, to recieve intereſt for the ſame at £6 per cent. per aunum, ſimple intereſt, and at the end of 12 years, received for principal and intereſt £860; what was the ſum lent? *Anſ.* £500.

3. A, B and C joined their ſtocks, and gained £350; of which, A took up a certain ſum; B took up four times ſo much as A, and C eight times ſo much as B; what ſhare of the gain had each?

	£.	s.	d.	qrs.	
Anſ.	9	9	2	$1\frac{3}{37}$	A's ſhare.
	37	16	9	$0\frac{12}{37}$	B's ditto.
	302	14	0	$2\frac{22}{37}$	C's ditto.

4. A, B, C and D ſpent 35s. at a reckoning, and being a little dipped, they agreed that A ſhould pay $\frac{2}{3}$, B $\frac{1}{2}$, C $\frac{1}{3}$, and D $\frac{1}{4}$; what did each pay in the above proportion?

		s.	d.
Anſ.	A,	13	4
	B,	10	
	C,	6	8
	D,	5	

5. A certain ſum of money is to be divided between 5 men, in ſuch a manner as that A ſhall have $\frac{1}{4}$, B $\frac{1}{5}$, C $\frac{1}{10}$, D $\frac{1}{20}$, and E the remainder, which is £40; what is the ſum?

Suppoſe £200 then $\frac{1}{4}+\frac{1}{5}+\frac{1}{10}+\frac{1}{20}=120$.
$200-120=80$, *As* 80 : 40 :: 200 : 100, *Anſ.*

6. A perſon after ſpending $\frac{1}{2}$ and $\frac{1}{3}$ of his money, had £$26\frac{2}{3}$ left ; what had he at firſt ?

Anſ. £160.

7. A and B talking of their ages, B ſaid his age was once and a half the age of A ; C ſaid his was twice and one tenth the age of both, and that the ſum of their ages was 93 ; what was the age of each ?

Anſ. A's 12, B's 18 and C's 63 years.

8. A veſſel has 3 cocks, A, B and C ; A can fill it in half an hour, B in $\frac{1}{4}$ of an hour, and C in $\frac{1}{5}$ of an hour ; in what time will they all fill it together ?

Anſ. $\frac{1}{9}$ hour.

9. A perſon having about him a certain number of dollars, ſaid that $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{1}{6}$ of them would make 57 ; Pray, how many had he ? *Anſ.* 60.

10. A gentleman bought a chaiſe, horſe and harneſs for £100 ; the horſe coſt $\frac{1}{4}$ more than the harneſs, and the chaiſe $\frac{1}{3}$ more than the horſe ; what was the price of each ?

Anſ. Har. £$25\frac{25}{47}$, horſe £$31\frac{43}{47}$, chaiſe £$42\frac{26}{47}$.

11. A and B, having found a purſe of money, diſputed who ſhould have it ; A ſaid the $\frac{1}{5}$ $\frac{1}{10}$ and $\frac{1}{20}$ of it amounted to £35, and if B could tell him how much was in it he ſhould have the whole, otherwiſe he ſhould have nothing : how much did the purſe contain ?

Anſ. £100.

12. A gentleman divided his fortune among his ſons ; to A he gave £9 as often as to B £5 ; and to C but £3 as often as to B £7, yet C's portion came to $1050\frac{4}{5}$; what was the whole eſtate ?

Anſ. £$9716\frac{2}{95}$.

13. Seven eighths of a certain number exceeds four fifths by 6 ; what is that number ?

Anſ. 80.

14. What number is that, which being increaſed by $\frac{2}{5}$, $\frac{3}{8}$ and $\frac{5}{6}$ of itſelf, the ſum will be $234\frac{3}{4}$?

Anſ. 90.

DOUBLE POSITION.

Double Poſition teaches to reſolve queſtions by making two ſuppoſitions of falſe numbers.

Thoſe queſtions, in which the reſults are not proportional to their poſitions, belong to this rule; ſuch are thoſe, in which the number ſought is increaſed or diminiſhed by ſome given number which is no known part of the number required.

Rule* 1.—Take any two convenient numbers and proceed with each, according to the conditions of the queſtion.

2. Place the reſult or errors againſt their poſitions or ſuppoſed numbers thus,

$$\begin{array}{cc}\text{Pos.} & \text{Err.}\\ 30 & 12\\ \multicolumn{2}{c}{\times}\\ 20 & 6\end{array}$$

and if the error be too great, mark it with +; and if too ſmall with —.

3. Multiply them croſſwiſe; that is, the firſt poſition by the laſt error, and the laſt poſition by the firſt error.

4. If the errors be alike; that is, both too ſmall, or both too great, divide the difference of the products by the difference of the errors, and the quotient will be the anſwer.

5. If the errors be unlike; that is, one too ſmall, and the other too great, divide the ſum of the products by the ſum of the errors, and the quotient will be the anſwer.

Note, When the errors are the ſame in quantity, and unlike in quality, half the ſum of the ſuppoſitions is the number ſought

Examples.

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[*] The rule is founded on this ſuppoſition, that the firſt error is to the ſecond, as the difference between the true and firſt ſuppoſed number is to the difference between the true and ſecond ſuppoſed number; when that is not the caſe, the exact anſwer to the queſtion cannot be found by this rule.

EXAMPLES.

1. A lady bought damaſk for a gown, at 8s. per yard, and lining for it at 3s. per yard; the gown and lining contained 15 yards, and the price of the whole was £3 10s.—How many yards were there of each?

Suppoſe 6 yards damaſk, value 48s.
Then ſhe muſt have 9 yards of lining, value 27s.

Sum of their values = 75s.
So that the firſt error is 5 too much, or + 5
Again ſuppoſe ſhe had 4 yards of damaſk, value 32s.
Then ſhe muſt have 11 yards of lining, value 33s.

Sum of their values = 65s.
So that the ſecond error is 5 too little, or − 5s.

$$\text{Then, }\begin{array}{cc} 6 & 5+ \\ \multicolumn{2}{c}{\times} \\ 4 & 5- \\ \hline 20 & 30 \\ & 20 \\ \hline \end{array}$$

$$\text{Sum of errors} = 5 + 5 = 10)\underline{50}$$

5 yds. at 8s. =	£ 2	0	0
10 yds, at 3s. =	1	10	0
	£ 3	10	0

(*Proof.*

Anſ. 5 yards damaſk, and 15−5=10 yds. (lining.

Or, 6+4÷2=5 as before.

2. A and B have the ſame income: A ſaves $\frac{1}{8}$ of his but B, by ſpending £30 per annum more than A, at the end of 8 years finds himſelf 40£ in debt; what is their income, and, what does each ſpend per annum?

$$\text{Suppoſe}\left\{\begin{array}{cc} 80 & 120+ \\ \multicolumn{2}{c}{\times} \\ 160 & 40+ \end{array}\right.$$

Anſ. Their income is £200 (per annum.
Alſo, A ſpends £175 and B (£205 per annum.

Then 80−10=70, A's expenſe per annum; and

$\underline{70+30} = \underline{100}$, B's expenſe per annum.——Then $100\times 8 - 80\times 8 = 160$, which ſhould have been 40; therefore $160-40=120$ more than it ſhould be, for the firſt error. In like manner proceed for the ſecond error.

3. A and B laid out equal ſums of money in trade: A gained a ſum equal to $\frac{1}{4}$ of his ſtock, and B loſt £225; then A's money was double that of B; what did each lay out?

$$\text{Suppoſe}\begin{cases}300 & 225+\\ & \times\\ 900 & 225-\end{cases}$$

Anſ. £600.

4. A labourer was hired for 60 days upon this condition, that, for every day he wrought, he ſhould receive 3s. 4d. and for every day he was idle, ſhould forfeit 1s. 8d.—at the expiration of the time he received £3 15s.; how many days did he work, and how many was he idle?

$$\text{Suppoſe he worked}\begin{cases}20 & 900-\\ & \times\\ 40 & 300+\end{cases}$$

Anſ. He was employed 35 days and was idle 25.

5. A gentleman has two horſes of conſiderable value, and a carriage worth £100. Now, if the firſt horſe be harneſſed in it, he and the carriage together will be triple the value of the ſecond; but if the ſecond be put in, they will be 7 times the value of the firſt; what is the value of each horſe?

$$\text{Suppoſe}\begin{cases}32 & 80-\\ & \times\\ 44 & 160-\end{cases}$$

Anſ. One £20 and the other £40.

6. There is a fiſh, whoſe head is 10 feet long; his tail is as long as his head and half the length of his body, and his body as long as the head and tail; what is the whole length of the fiſh?

Head=10
Firſt, ſuppoſe the body 20 10—Tail=30
X Body=40
2d, ſuppoſe it 30 5— —
Anſ. 80 feet.

7. What number is that, which being increaſed by its $\frac{1}{2}$, its $\frac{1}{4}$, and 5 more, will be doubled ?

Suppoſe { 8 3+
X *Anſ.* 20
16 1+

8. A farmer having driven his cattle to market, received for them all, £80, being paid at the rate of £6 per ox, £4 per cow, and £1 10s. per calf; there were as many oxen as cows, and 4 times as many calves as cows: How many were there of each ſort ?

Suppoſe cows 6 16+
X
Suppoſe 12 112+
Anſ. 5 oxen, 5 cows, and 20 calves.

9. A, B and C built a ſhip, which coſt them £1000—of which A paid a certain ſum—B paid £100 more than A, and C £100 more than both; having finiſhed her, they fixed her for ſea with a cargo worth twice the value of the ſhip: The outfits and charges of the voyage amounted to $\frac{1}{8}$ of the ſhip; upon the return of which, they found their clear gain to be $\frac{2}{3}$ of $\frac{1}{5}$ of the veſſel, cargo and expenſes: Pleaſe to inform me what the ſhip coſt them ſeverally; what ſhare each had in her, and what, upon the final adjuſtment of their accompts, they had ſeverally gained ?

Suppoſe it coſt A £100 300—
X
Suppoſe - - - 200 100+

A owned $\frac{7}{40}$ of the ſhip, which coſt him £175, and his ſhare of the gain was £218 15s.—B owned $\frac{11}{40}$, which coſt £275, and his gain was £343 15s.—C owned $\frac{11}{20}$, which coſt £550, and his gain was £687 10s.

PERMUTATIONS AND COMBINATIONS.

The Permutation of Quantities is the ſhewing how many different ways any given number of things may be changed.

This is alſo called variation, alternation, or changes; and the only thing to be regarded here is the order they ſtand in; for no two parcels are to have all their quantities placed in the ſame ſituation

The Combination of Quantities is the ſhewing how often a leſs number of things can be taken out of a greater, and combined together, without conſidering their places, or the order they ſtand in.

This is ſometimes called election, or choice; and here every parcel muſt be different from all the reſt, and no two are to have preciſely the ſame quantities or things.

The Compoſition of Quantities is the taking of a given number of quantities out of as many equal rows of different quantities, one out of every row, and combining them together.

Here, no regard is had to their places; and it differs from Combination, only, as that admits but of one row of things.

PROBLEM I.

To find the number of permutations, or changes, that can be made of any given number of things, all different from each other.

RULE.* Multiply all the terms of the natural ſeries of numbers, from 1 up to the given number, continually together and the laſt product will be the anſwer required.

EXAMPLES.

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* Any two things *a* and *b* are capable of two variations only; as *ab*, *ba*; whoſe number is expreſſed by 1 × 2.

If there be three things, *a*, *b*, and *c*, then any two of them, leaving out the third, will have 1×2 variations; and conſequently when the third is taken in, there will be 1×2×3 variations; and ſo on, as far as you pleaſe.

EXAMPLES.

1. Chriſt Church, in Boſton, has 8 bells; how many changes may be rung on them?

$1\times2\times3\times4\times5\times6\times7\times8=40320$ the *Anſ.*

2. Nine gentlemen met at an inn, and were ſo pleaſed with their hoſt, and with each other, that in a frolick they agreed to tarry ſo long as they, together with their hoſt, could ſit every day in a different poſition at dinner; pray how long, had they kept their agreement, would their frolick have laſted? *Anſ.* 994$\frac{335}{365}$ years.

3. How many changes or variations will the alphabet admit of? *Anſ.* 620448401733239439360000.

PROBLEM 2.

Any number of different things being given—to find how many changes can be made out of them, by taking any given number of quantities at a time.

RULE. Take a ſeries of numbers, beginning at the number of things given, and decreaſing by one, to the number of quantities to be taken at a time; the product of all the terms will be the anſwer required.

EXAMPLES.

1. How many changes may be rung with 4 bells out of 8?

$8\times7\times6\times5(=4$ terms$)=1680$ the *Anſ.*

2. How many words can be made with 6 letters of the alphabet, admitting a number of conſonants may make a word? *Anſ.* 96909120.

PROBLEM 3.

Any number of things being given—whereof there are ſeveral things of one ſort, ſeveral of another, &c. To find how many changes may be made out of them all.

RULE* 1. Take the ſeries $1\times2\times3\times4$, &c. up to the

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* Any 2 quantities, *a*, *b*, both different, admit of two changes; but if the quantities are the ſame, or *ab* become *aa*, there will be one alteration, which may be expreſſed by $\frac{1\times2}{1\times2}=1$

Any

the number of things given, and find the product of all the terms.

2. Take the ſeries 1 × 2 × 3 × 4, &c. up to the number of the given things of the firſt ſort, and the ſeries, 1 × 2 × 3 × 4, &c. up to the number of the given things of the ſecond ſort, &c.

3. Divide the product of all the terms of the firſt ſeries by the joint product of all the terms of the remaining ones and the quotient will be the anſwer required.

EXAMPLES.

1. How many variations may be made of the letters in the word Zaphnathpaaneah?

1×2×3×4×5×6×7×8×9×10×11×12×13×14×15 (= number of letters in the word) =1307674368000.

1×2×3×4×5 (=number of a's)=120

1×2 (=number of p's)= 2

1 (=number of t's)= 1

1×2×3 (=number of h's)= 6

1×2 (=number of n's)= 2

2×6×1×21×20=2880)1307674368000(454053600—the *Anſ.*

2. How many different numbers can be made of the following figures, 1223334444? *Anſ.* 12600.

PROBLEM 4.

To find the number of combinations of any given number of things, all different from one another, taking one given number at a time.

RULE* 1. Take the ſeries 1, 2, 3, 4, &c. up to the

the

Any 3 quantities, *a*, *b*, *c*, all different from each other, admit of 6 variations; but if the quantities are all alike, or *abc* become *aaa*, then the 6 variations will be reduced to 1, which may be expreſſed by $\frac{1\times2\times3}{1\times2\times3}=1$. Again if two quantities out of three are alike, or, *abc*, become *aac*; then the 6 variations will be reduced to theſe 3, *aac*, *caa*, *aca*, which may be expreſſed by $\frac{1\times2\times3}{1\times2}=3$ and ſo of any greater number.

* In any given number of quantities, the number of combinations increaſes gradually until you come about the mean num-

bers,

the number to be taken at a time, and find the product of all the terms.

2. Take a ſeries of as many terms, decreaſing by 1, from the given number, out of which the election is to be made, and find the product of all the terms.

3. Divide the laſt product by the former, and the quotient will be the number ſought.

EXAMPLES.

1. How many combinations may be made of 7 letters out of 12?

$1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7$ (= the number to be taken at a time,) } = 5040

$12 \times 11 \times 10 \times 9 \times 8 \times 7 \times 6$ (= ſame number from 12) } = 3991680.

5040)3991680(792 the *Anſ.*

2. How many combinations can be made of 6 letters out of the 24 letters of the alphabet? *Anſ.* 134596.

3. A general was aſked by his king, what reward he ſhould confer on him for his ſervices; the general only required a penny for every file, of 10 men in a file, which he could make out of a company of 90 men: What did it amount to? *Anſ.* £23836022841 7s. $11\frac{65}{1124}$.

4. A farmer bargained with a gentleman for a dozen ſheep (at 2 dollars per head) which were to be picked out of 2 dozen; but being long in chooſing them, the gentleman told him that if he would give him a penny for every different dozen which might be choſen out of the two dozen, he ſhould have the whole, to which the farmer readily agreed: Pray what did they coſt him?

Anſ. £11267 6/4.

PROBLEM

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bers, and then gradually decreaſes. If the number of quantities be even, half the number of places will ſhew the greateſt number of combinations, that can be made of thoſe quantities; but if odd, then thoſe two numbers, which are the middle, and whoſe ſum is equal to the given number of quantities, will ſhew the greateſt number of combinations.

PROBLEM 5.

To find the compoſitions of any number, in an equal number of ſets, the things being all different.

Rule. Multiply the number of things in every ſet continually together, and the product will be the anſwer required.

EXAMPLES.

1 Suppoſe there are 5 companies, each conſiſting of 12 men: it is required to find how many ways 9 men may be choſen one out of each company?

$9\times9\times9\times9\times9=59049$ different ways.

2. How many chances are there in throwing 4 dice? As a die has 6 ſides, multiply 6 into itſelf three times continually. $6\times6\times6\times6=1296$ chances, *Anſ.*

3. Suppoſe a man undertakes to throw an ace at one throw with 4 dice; what is the probability of his effecting it?

Firſt, $6\times6\times6\times6=1296$ different ways with and without the ace;

Then, if we exclude the ace ſide of the die, there will be five ſides left and $5\times5\times5\times5=625$ ways without the ace; therefore there are $1296-625=671$ ways, wherein one or more of them may turn up an ace: and the probability that he will do it, as 671 to 625, *Anſ.*

THE USE OF LOGARITHMS.

1. In Multiplication.

Given two numbers, viz 275 and 12,6 to find their product.

Rule. To the logarithm of 275, viz 2,43933
Add the logarithm, of 12,6, viz. - - 1,10037
And their ſum is the logarithm of their product viz. } 3465=3,53970

2. In Division.

Let it be required to find the quotient, which ariſes by dividing one number by another; ſuppoſe 1425 by 57.

From the logarithm of the dividend, viz. 1425=3,15381
Take the logarithm of the diviſor, viz. 57 =1,75587
And the remainder is the logarithm of the quotient, viz. 25=1,3979

3. In the Rule of Three.

Three numbers given to find a fourth, in direct proportion.

Rule. From the Tables take the logarithms of each of the propoſed numbers, then add the logarithms of the ſecond and third together, and from the ſum take the logarithm of the firſt, and the remainder will be the logarithm of the fourth number.

Let the three propoſed numbers be 18, 24 and 33 and the operatiou will ſtand thus.

1,38021=the logarithm of 24, the 2d term.
1,51851=the logarithm of 33, the 3d term.
2,89872=the logarithm of their product.
—1,25527=the logarithm of the firſt term 18.
1,64345=the logarithm of the 4th term required, which, by the Table, anſwers to the natural number 44, the 4th proportional to the three propoſed numbers.

4. In Involution, or Raising Powers.

To find any power of any propoſed number, or to involve any number to any propoſed power, by logarithms.

Rule. Multiply the logarithm of the given root by the power, viz. by 2 for the ſquare, by 3 for the cube, &c. and the product is the logarithm of the power ſought.

Required to find the cube of 12?

1,07918=the logarithm of 12.
×3=the third power, or cube.
3,23754=1728 the cube of 12.

5. In Evolution, or Extracting Roots.

To Extract any Root of any propoſed number.

Rule. Divide the logarithm of the propoſed number by the index of the required root, viz, by 2 for the ſquare, by 3 for the cube, &c. and the quotient will be the logarithm of the root required.

Required to ſind the cube root of 1728?

3,23754=the logarithm of 1728, and 3,23754÷3=1,07918 is the logarithm of the cube root of 1728, viz. 12.

6. In Compound Intereſt.

To ſind the amount of any ſum for any time, and at any rate at compound intereſt.

Rule. Multiply the logarithm of the ratio (i. e. the amount of 1l. for 1 year) by the number of years, and to the product add the logarithm of the principal; the ſum will be the logarithm of the amount.

What will 40l. amount to, forborne 12 years, at 6 per cent. per annum, compound intereſt?

Log. of 1,06, the ratio, is ,02533
Multiply by the time 12

,30396
Add Log. of 45, the principal 1,65321

The ſum is 1,95717 which is the logarithm of 90,7=£90 14s. *Anſ.*

7. In Diſcount at Compound Intereſt.

To ſind the preſent worth of any ſum of money, due any time hence, at any rate, at compound intereſt.

Rule. From the logarithm of the ſum to be diſcounted, ſubtract the logarithm of the rate multiplied by the time; and the remainder is the logarithm of the preſent worth.

What preſent money will pay a debt of 90l. 14s. due 12 years hence, diſcounting at the rate of 6 per cent. per annum?

From the logarithm of £90 14=1,95717
Sub. product of the Log. of the ratio X by the time } =,30396

The remainder 1,65421 is the logarithm of £45 *Anſ.*

N. Ham.

N. Hamp Maſſach. R. Iſland, Connecticut and Virginia.			*Federal Coin.*	*New-York and North-Carolina.*			*N. Jerſey, Pennſylv. Delaware and Maryland.*			*S. Carolina and Georgia.*			*French Money.*	
£.	s.	d.	*Dol. d. c*	£.	s.	d.	£.	s.	d.	£.	s.	d	Liver. Tour.	*Sous*
		1	0,01$\frac{7}{18}$			1$\frac{1}{3}$			1$\frac{1}{4}$			$\frac{7}{9}$		1$\frac{11}{24}$
		2	0,02$\frac{7}{9}$			2$\frac{2}{3}$			2$\frac{1}{2}$			1$\frac{5}{9}$		2$\frac{11}{12}$
		3	0,04$\frac{1}{6}$			4			3$\frac{3}{4}$			2$\frac{3}{9}$		4$\frac{3}{9}$
		4	0,05$\frac{5}{9}$			5$\frac{1}{3}$			5			3$\frac{1}{9}$		5$\frac{5}{6}$
		5	0,06$\frac{8}{9}$			6$\frac{2}{3}$			6$\frac{1}{4}$			3$\frac{8}{9}$		7$\frac{7}{24}$
		6	0,08$\frac{1}{3}$			8			7$\frac{1}{2}$			4$\frac{6}{9}$		8$\frac{3}{4}$
		7	0,09$\frac{2}{3}$			9$\frac{1}{3}$			8$\frac{3}{4}$			5$\frac{4}{9}$		10$\frac{5}{24}$
		8	0,11$\frac{1}{9}$			10$\frac{2}{3}$			10			6$\frac{2}{9}$		11$\frac{2}{3}$
		9	0,12$\frac{1}{2}$		1	0			11$\frac{1}{4}$			7		13$\frac{1}{3}$
		10	0,13$\frac{8}{9}$		1	1$\frac{1}{3}$		1	0$\frac{1}{2}$			7$\frac{7}{9}$		14$\frac{7}{12}$
		11	0,15$\frac{1}{3}$		1	2$\frac{2}{3}$		1	1$\frac{3}{4}$			8$\frac{5}{9}$		16$\frac{1}{24}$
	1	0	0,16$\frac{2}{3}$		1	4		1	3			9$\frac{3}{9}$		17$\frac{1}{2}$
	2	0	0,33$\frac{1}{3}$		2	8		2	6		1	6$\frac{6}{9}$	1	15
	3	0	0,50		4	0		3	9		2	4	2	12$\frac{1}{2}$
	4	0	0,66$\frac{2}{3}$		5	4		5	0		3	1$\frac{3}{9}$	3	10
	5	0	0,83$\frac{1}{3}$		6	8		6	3		3	10$\frac{6}{9}$	4	7$\frac{1}{2}$
	6	0	1,00		8	0		7	6		4	8	5	5
	7	0	1,16$\frac{2}{3}$		9	4		8	9		5	4$\frac{3}{9}$	6	2$\frac{1}{2}$
	8	0	1,33$\frac{1}{3}$		10	8		10	0		6	2$\frac{6}{9}$	7	0
	9	0	1,50		12	0		11	3		7	0	7	17$\frac{1}{2}$
	10	0	1,66$\frac{2}{3}$		13	4		12	6		7	9$\frac{3}{9}$	8	15
1	0	0	3,33$\frac{1}{3}$	1	6	8	1	5	0		15	6$\frac{6}{9}$	17	10
2	0	0	6,66$\frac{2}{3}$	2	13	4	2	10	0	1	11	1$\frac{3}{9}$	35	
3	0	0	10,00	4	0	0	3	15	0	2	6	8	52	10
4	0	0	13,33$\frac{1}{3}$	5	6	8	5	0	0	3	2	2$\frac{6}{9}$	70	
5	0	0	16,66$\frac{2}{3}$	6	13	4	6	5	0	3	17	9$\frac{3}{9}$	87	10
6	0	0	20,00	8	0	0	7	10	0	4	13	4	105	
7	0	0	23,33$\frac{1}{3}$	9	6	8	8	15	0	5	8	10$\frac{6}{9}$	122	10
8	0	0	26,66$\frac{2}{3}$	10	13	4	10	0	0	6	4	5$\frac{3}{9}$	140	
9	0	0	30,00	12	0	0	11	5	0	7	0	0	157	10
10	0	0	33,33$\frac{1}{3}$	13	6	8	12	10	0	7	15	6$\frac{6}{9}$	175	

Federal Money.	*N Hampſhire, Maſſachuſetts, R. Iſland, Connecticut & Virginia*			*New-York and N. Carolina.*			*N. Jerſey, Pennſylva. Delaware and Maryland.*			*S. Carolina and Georgia.*			*French.*	
D. d. c.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	Liver. Tour.	*Sous.*
0,0 1			$\frac{18}{25}$			$\frac{24}{25}$			$\frac{9}{10}$			$\frac{14}{25}$		$1\frac{1}{20}$
0,0 2			$1\frac{11}{25}$			$1\frac{23}{25}$			$1\frac{8}{10}$			$1\frac{3}{25}$		$2\frac{1}{10}$
0,0 3			$2\frac{4}{25}$			$2\frac{22}{25}$			$2\frac{7}{10}$			$2\frac{17}{25}$		$3\frac{3}{20}$
0,0 4			$3\frac{22}{25}$			$3\frac{21}{25}$			$3\frac{6}{10}$			$2\frac{6}{25}$		$4\frac{1}{5}$
0,0 5			$3\frac{3}{5}$			$4\frac{4}{5}$			$4\frac{5}{10}$			$3\frac{4}{25}$		$5\frac{1}{4}$
0,0 6			$4\frac{3}{25}$			$5\frac{19}{25}$			$5\frac{4}{10}$			$3\frac{9}{25}$		$6\frac{3}{10}$
0,0 7			$5\frac{1}{25}$			$6\frac{13}{25}$			$6\frac{3}{10}$			$3\frac{23}{25}$		$7\frac{7}{20}$
0,0 8			$5\frac{19}{25}$			$7\frac{17}{25}$			$7\frac{2}{10}$			$4\frac{12}{25}$		$8\frac{3}{5}$
0,0 9			$6\frac{12}{25}$			$8\frac{16}{25}$			$8\frac{1}{10}$			$5\frac{1}{25}$		$9\frac{9}{20}$
0,1 0			$7\frac{1}{5}$			$9\frac{3}{5}$			9			$5\frac{3}{5}$		$10\frac{1}{2}$
0,2 0		1	$2\frac{2}{5}$		1	$7\frac{1}{5}$		1	6			$11\frac{1}{5}$	1	1
0,3 0		1	$9\frac{3}{5}$		2	$4\frac{4}{5}$		2	3		1	$4\frac{4}{5}$	1	$11\frac{1}{2}$
0,4 0		2	$4\frac{4}{5}$		3	$2\frac{2}{5}$		3	0		2	$10\frac{2}{5}$	2	2
0,5 0		3	0		4	0		3	9		2	4	2	$12\frac{1}{2}$
0,6 0		3	$7\frac{1}{5}$		4	$9\frac{1}{5}$		4	6		2	$9\frac{3}{5}$	3	3
0,7 0		4	$2\frac{2}{5}$		5	$7\frac{2}{5}$		5	3		3	$3\frac{1}{5}$	3	$13\frac{1}{2}$
0,8 0		4	$9\frac{3}{5}$		6	$4\frac{4}{5}$		6	0		3	$8\frac{4}{5}$	4	4
0,9 0		5	$4\frac{4}{5}$		7	$2\frac{1}{5}$		6	9		4	$2\frac{2}{5}$	4	$14\frac{1}{2}$
1,0 0		6	0		8	0		7	6		4	8	5	5
2,0 0		12	0		16	0		15	0		9	4	10	10
3,0 0		18	0	1	4	0	1	2	6		14	0	15	15
4,0 0	1	4	0	1	12	0	1	10	0		18	8	21	0
5,0 0	1	10	0	2	0	0	1	17	6	1	3	4	26	5
6,0 0	1	16	0	2	8	0	2	5	0	1	8	0	31	10
7,0 0	2	2	0	2	16	0	2	12	6	1	12	8	36	15
8,0 0	2	4	0	3	4	0	3	0	0	1	17	4	42	0
9,0 0	2	14	0	3	12	0	3	7	6	2	2	0	47	5
10,0 0	3	0	0	4	0	0	3	15	0	2	0	8	52	10
20,0 0	6	0	0	8	0	0	7	10	0	4	13	4	105	0
30,0 0	9	0	0	12	0	0	11	5	0	7	0	0	157	10
40,0 0	12	0	0	16	0	0	15	0	0	9	6	8	210	0
50,0 0	15	0	0	20	0	0	18	15	0	11	13	4	265	10

A Table, directing how to buy and ſell by the Hundred.

d.	£.	s.	d.	s.	d.	£.	s.	d.	s.	d.	£.	s.	d.
¼	0	2	4		8¼	3	17	0	1	4¼	7	11	8
½	0	4	8		8½	3	19	4	1	4½	7	14	0
¾	0	7	0		8¾	3	1	8	1	4¾	7	16	4
1	0	9	4		9	4	4	0	1	5	7	18	8
1¼	0	11	8		9¼	4	6	4	1	5¼	8	1	0
1½	0	14	0		9½	4	8	8	1	5½	8	3	4
1¾	0	16	4		9¾	4	11	0	1	5¾	8	5	8
2	0	18	8		10	4	13	4	1	6	8	8	0
2¼	1	1	0		10¼	4	15	8	1	6¼	8	10	4
2½	1	3	4		10½	4	18	0	1	6½	8	12	8
2¾	1	5	8		10¾	5	0	4	1	6¾	8	15	0
3	1	8	0		11	5	2	8	1	7	8	17	4
3¼	1	10	4		11¼	5	5	0	1	7¼	8	19	8
3½	1	12	8		11½	5	7	4	1	7½	9	2	0
3¾	1	15	0		11¾	5	9	8	1	7¾	9	4	4
4	1	17	4		12	5	12	0	1	8	9	6	8
4¼	1	19	8	1	0¼	5	14	4	1	8¼	9	9	0
4½	2	2	0	1	0½	5	16	8	1	8½	9	11	4
4¾	2	4	4	1	0¾	5	19	0	1	8¾	9	13	8
5	2	6	8	1	1	6	1	4	1	9	9	16	0
5¼	2	9	0	1	1¼	6	3	8	1	9¼	9	18	4
5½	2	11	4	1	1½	6	6	0	1	9½	10	0	8
5¾	2	13	8	1	1¾	6	8	4	1	9¾	10	3	0
6	2	16	0	1	2	6	10	8	1	10	10	5	4
6¼	2	18	4	1	2¼	6	13	0	1	10¼	10	7	8
6½	3	0	8	1	2½	6	15	4	1	10½	10	10	0
6¾	3	3	0	1	2¾	6	17	8	1	10¾	10	12	4
7	3	5	4	1	3	7	0	0	1	11	10	14	8
7¼	3	7	8	1	3¼	7	2	4	1	11¼	10	17	0
7½	3	10	0	1	3½	7	4	8	1	11½	10	19	4
7¾	3	12	4	1	3¾	7	7	0	1	11¾	11	1	8
8	3	14	8	1	4	7	9	4	2	0	11	4	0

A TABLE for reducing Troy Weight to Avoirdupois.

Troy.	*Avoirdupois.*			*Troy.*	*Avoir.*
lb.	lb.	*oz.*	*drams.*	*pwt.*	*drams.*
4000	3091	6	13,68	19	16,67
3000	2528	9	2.26	18	15,79
2000	1645	11	6,84	17	14,92
1000	822	13	1,42	16	14,04
900	740	9	2,28	15	13,16
800	658	4	9,14	14	12,29
700	576	0	0,	13	11,41
600	493	11	6,85	12	10,53
500	411	6	13,71	11	8 65
400	329	2	4,57	10	9,78
300	246	13	11,42	9	7,9
200	164	9	2,28	8	7,02
100	82	4	9,15	7	6,14
90	74	0	13 62	6	5,27
80	65	13	4,11	5	4.39
70	57	9	9 6	4	3,51
60	49	5	15,08	3	2,63
50	41	2	4,57	2	1.75
40	32	14	10,05	1	0,88
30	24	10	19,54	*gr.*	
20	16	7	5,03	23	,84
10	8	3	10.52	22	,8
9	7	6	7,86	21	,77
8	6	9	5,21	20	,73
7	5	12	2,56	19	,69
6	4	14	15,9	18	,66
5	4	1	13,25	17	,62
4	3	4	10.6	16	,58
3	2	7	7,95	15	,55
2	1	10	5,3	14	,51
1	0	13	2,65	13	,47
				12	,44
oz.		12	1,09	11	,4
11		10	15.54	10	,36
10		9	13.99	9	,33
9		8	12,43	8	,29
8		7	10.88	7	,26
7		6	9,32	6	,22
6		5	7.77	5	,18
5		4	6 22	4	,15
4		3	4,66	3	,11
3		2	3,11	2	,07
2		1	1,55	1	,04
1					

A Table for reducing Avoirdupois Weight to Troy Weight.

Avoir.	*Troy.*				*Av.*	*Troy.*			
lb.	lb.	*oz.*	*pwt.*	*gr.*	*oz.*	lb.	*oz.*	*pwt.*	*gr.*
6000	7291	8	0	0	15	1	1	13	10,5
5000	6076	4	13	8	14	1	0	15	5
4000	4861	1	6	16	13		11	16	23,5
3000	3645	10	0	0	12		10	18	18
2000	2430	6	13	8	11		10	0	12,5
1000	1215	3	6	16	10		9	2	7
900	1093	9	0	0	9		8	4	1,5
800	972	2	13	8	8		7	5	20
700	850	8	6	16	7		6	7	14,5
600	729	2	0	0	6		5	9	9
500	607	7	13	8	5		4	11	3,5
400	486	1	6	16	4		3	12	22
300	364	7	0	0	3		2	14	16,5
200	243	0	13	8	2		1	16	11
100	121	6	6	16	1			18	5,5
90	109	4	10	0	*dr.*				
80	97	2	13	8	15			17	2,1
70	85	0	16	16	14			15	22,76
60	72	11	0	0	13			14	19,42
50	60	9	3	8	12			13	15,08
40	48	7	6	16	11			12	12,74
30	36	5	10	0	10			11	9,4
20	24	3	13	8	9			10	6,06
10	12	1	16	16	8			9	2,72
9	10	11	5	0	7			8	23,39
8	9	8	13	8	6			7	20,04
7	8	6	1	16	5			6	16,7
6	7	3	10	0	4			5	13,36
5	6	0	18	8	3			3	10,02
4	4	10	6	16	2			2	6,68
3	3	7	15	0	1			1	3,34
2	2	5	3	8	$\frac{3}{4}$				20,51
1	1	2	11	16	$\frac{1}{2}$				13,67

APPENDIX.

CONGRESS have made foreign Gold and Silver Coins a legal tender for the payment of all debts and demands, at the ſeveral and reſpective rates following, viz. The Gold Coins of Great-Britain and Portugal, of their preſent ſtandard, at the rate of 100 cents for every 27 grains of the actual weight thereof—Thoſe of France and Spain, 27⅖ grains of the actual weight thereof—Spaniſh Milled Dollars, weighing 17 pwt. 7 grs. equal to 100 cents, and in proportion for the parts of a dollar—Crowns of France, weighing 18 pwt. 17 grs. equal to 110 cents, and in proportion for the parts of a Crown. They have enacted, That every cent ſhall contain 208 grains of copper, and every half cent 104 grains; agreeably to which, the following Tables are calculated.

WEIGHTS *of ſeveral pieces of Engliſh, Portugueſe, and French Gold Coins, according to a late Act of Congreſs, paſſed November,* 1792.

	Pwt.	*Gr.*	*Doll.*	*Cents.*	*Mills.*
Double Johannes	18		16	0	0
Single ditto -	9		8		
Engliſh Guinea	5	6	4	66⅔	
Half ditto - -	2	15	2	33⅓	
French Guinea	5	6	4	59	8
Half ditto - -	2	15	2	29	9
4 Piſtoles - -	16	12	14	45	2
2 Piſtoles - -	8	6	7	22	6
1 Piſtole - -	4	3	3	61	3
Moidore - - -	6	22	6	14	8

WEIGHT *of Engliſh and Portugueſe Gold, in Dollars, Cents and Mills, agreeably to an Act of Congreſs, paſſed in the Seſſion of November,* 1792.

Grs.	*Cents.*	*Mills*	*Pwts.*	*Dolls.*	*Cents.*	*Mills.*
1	3	7	1	0	89	
2	7	4	2	1	77¾	
3	11	1	3	2	66⅔	
4	14	8	4	3	55½	
5	18½		5	4	44	4
6	22	2	6	5	33⅓	
7	25	9	7	6	22	2
8	29	6	8	7	11	1
9	33⅓		9	8		
10	37		10	8	89	
11	40	7	11	9	77¾	
12	44	4	12	10	66⅔	
13	48	1	13	11	55½	
14	51	8½	14	12	44	4
15	55	5½	15	13	33⅓	
16	59¼		16	14	22	2
17	63		17	15	11	1
18	66⅔		18	16		
19	70	4	19	16	89	
20	74	0¾	*oz.*			
21	77¾		1	17	77¾	
22	81½		2	35	55½	
23	85	2	3	53	33⅓	

WEIGHT *of French and Spaniſh Gold, in Dollars, Cents and Mills, agreeably to the Act aforeſaid.*

Grſ.	*Cents.*	*Mills.*	*Pwts.*	*Dollſ.*	*Cents.*	*Mills.*
1	3	6½	1	0	87	6
2	7	3	2	1	75	2
3	11		3	2	62¾	
4	14	6	4	3	50	3½
5	18	2½	5	4	38	
6	21	9	6	5	25	5½
7	25	5½	7	6	13	1⅓
8	29	2	8	7	0	7¼
9	32	8½	9	7	88	3
10	36½		10	8	76	
11	40	1½	11	9	63½	
12	43	8	12	10	51	1
13	47	4½	13	11	38	7
14	51	1	14	12	26	3
15	54¾		15	13	13	9
16	58	4	16	14	1½	
17	62	0½	17	14	89	0½
18	65	7	18	15	76	6½
19	69	3½	19	16	64	2½
20	73		*oz.*			
21	76	6½	1	17	51	8⅓
22	80	3	2	35	3	6½
23	83	9½	3	52	55½	

FINIS.

If Wisdoms ways
Youd wisely seek
Five things observe with care
To whom ye speak
Of whom you speak
And how and when and wh

James Peter
June 16 1822

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